QuickStart

User Manual

BL3410E2-D04-AC120

Plug-n-Play Servo System
with digital drive, brushless motor and cables
(10.5 lb-in, 6000 rpm)

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ADVANCED MOTION CONTROLS

Thank you for purchasing this QuickStart package!
QuickStart makes it easy to set up Advanced Motion Controls drives to get your system running quickly. The drive and motor have been matched with each other, the cables are custom made for this system and an interface board simplifies integration with your controller.

Remember, if you need us, we are here for you!
Our goal is to get you up and running as quickly as possible. If at any point you have a question, a team of applications engineers and our customer service staff are just a phone call away. We are available weekdays from 8am to 5pm Pacific Time at **805-389-1935**. We can also be contacted via email through our website www.a-m-c.com - go to "Contact Us".

4 steps to success!

1	2	3	4
Getting Started What's included with QuickStart and what to expect.	**5-Minute QuickStart** Lets spin the motor!	**Integrate QuickStart into your System** Get your machine working.	**Going into Production** Transitioning from prototype to production.

This manual has been laid out in four sections to guide you through the process of setting up and integrating your QuickStart system. By following each step in succession you will first be introduced to QuickStart, then hook up the system for a simple bench test, and then integrate QuickStart into your machine and finally transition into the production stage.

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1
Getting Started

BL3410E2-D04-AC120

What to Expect

What is 'QuickStart'?
QuickStart is a system offering including: a drive, a motor, all necessary cables, and an interface board with screw terminal connections - all in one box ready for fast delivery!

What purpose does 'QuickStart' serve?
QuickStart is intended to introduce OEMs to Advanced Motion Controls servo drives and provide a positive first experience.

Why is Advanced Motion Controls offering a 'QuickStart' package?
We realize that many OEMs today are faced with trying to get their machinery to market using the fastest possible methods. Our solution is to provide a means by which motion control can be quickly proven.

How does 'QuickStart' benefit new users?
QuickStart is designed to make system prototyping easier to include Advanced Motion Controls' servo drives. The attraction to OEM's is a savings of time, money and the personnel needed to move from conception to production. Preconfigured wiring means you can have the motor turning within 5 minutes of opening the box!

Are the motors available for individual resale?
Quite simply, not from Advanced Motion Controls. The motors in these packages are meant to represent what is commonly available from many different manufacturers. Your local Advanced Motion Controls representative can handle requests for motor model information for additional purchases.

How is 'QuickStart' pricing important to me?
Careful selection of systems incorporate popular Advanced Motion Control's servo drives in order to maximize exposure and minimize costs.

What other considerations should you know about 'QuickStart'?
Although it will be hard to find easy-to-configure systems like these at lower prices anywhere, QuickStart isn't intended for multiple, pre-packaged system selling. Initial exposure to Advanced Motion Controls' drives is the key. Each project will be followed up by our Sales department to determine overall progress and assist in determining the next step.

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1
Getting Started

Package Contents Checklist

☐ Digital Servo Drive	DPRAHIE-015N400
☐ Brushless NEMA 34 Motor w/encoder	MBL3410E2
☐ Screw Terminal Board	System Interface Board (SIB)
☐ Feedback / Commutation Cable (10 foot)	CBL-F02-10
☐ Motor Power Cable (10 foot)	CBL-P05-10
☐ Drive Cable (1.5 foot)	CBL-D03
☐ RS232 Communication Cable	CBL-RS232
☐ Documentation	Quick Connect Sheet
	User Manual
	Brochure with CD ROM

Additional Requirements

Item	Notes
Power Source	**Requirements:** • **120VAC 60 Hz Single Phase** **or** • **208VAC 60 Hz Three Phase** Acceptable Operating Range 40 – 250 VAC Single Phase or Three Phase
Controller	**Supported Command Inputs:** • +/-10V command signal • Step and Direction (24V) • Encoder Following (electronic gearing)
Windows PC	Computer with serial port to run the DriveWare software for drive configuration.

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2
5-Minute QuickStart

Let's spin the motor!

This quick setup procedure will get the motor moving in a short amount of time *without the need for a controller*. The drive has been pre-configured for velocity mode with a slight offset. This will turn the motor at a slow steady speed on power-up to demonstrate operation. Once the system is shown to be operational, the next section **Integrating QuickStart into your System** will guide you through the process of integrating the system into your application.

Wiring

On page 7 you will find the cables and connections sheet. Use this as a reference when following the steps in this section.

Drive

Connect either end of cable CBL-D03 to the I/O connector on the drive. Connect the other end to the C2 connector on the system interface board (SIB).

Feedback

CBL-F02-10 is the feedback cable. Connect the black connectors and shield drain wire on this cable to the corresponding connectors on the motor. Connect the 15pin D-sub end of this cable to the Feedback connector on the Drive.

Motor and System Power

Connect the white connector on the motor power cable CBL-P05-10 to the corresponding connector on the motor. Connect the other end of the cable to the Power connector on the drive.

Red	Motor Power A
White	Motor Power B
Black	Motor Power C
White AC	Power L1
Black AC	Power L2

The drive is set up to use 120VAC single phase as the power source. Do not apply power at this time. An AC power strip or other switch can be used to make cycling power more convenient during testing.

Grounding

Bring all ground wires to a central point ground such as a ground bus, ground plane or a single ground bolt. Also don't forget to ground the drive chassis! Use the screw marked PE on the case.

Motor Ground – Ground the motor through direct contact with the machine housing or a short heavy wire from the motor to earth ground. The green wire coming from motor power cable should only be used if you can't bring the motor case directly to ground. Don't ground the motor at both the green wire and the motor case since this creates a ground loop that disrupts the feedback signals.

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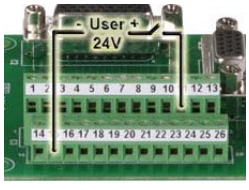
Inhibit Switch (optional for this section)

Digital Input 1 has been assigned as the Inhibit function and this can be used to inhibit/enable the drive. To do this you will need a switch and a 24V supply.

1. Bring the 24V ground to pin 15 (input common).
2. Tie one terminal of the switch to +24V and the other to pin 11.

With this configuration, opening the switch Enables the drive, closing the switch Disables the drive.



User Interface and RS232 Cable

The user interface and RS232 Cable should not be hooked up for the 5-Minute QuickStart procedure.

Cautions

Unexpected motion – To prevent the motor from jumping unexpectedly and causing damage, the motor should be secured either with clamps or bolted down using its mounting holes.

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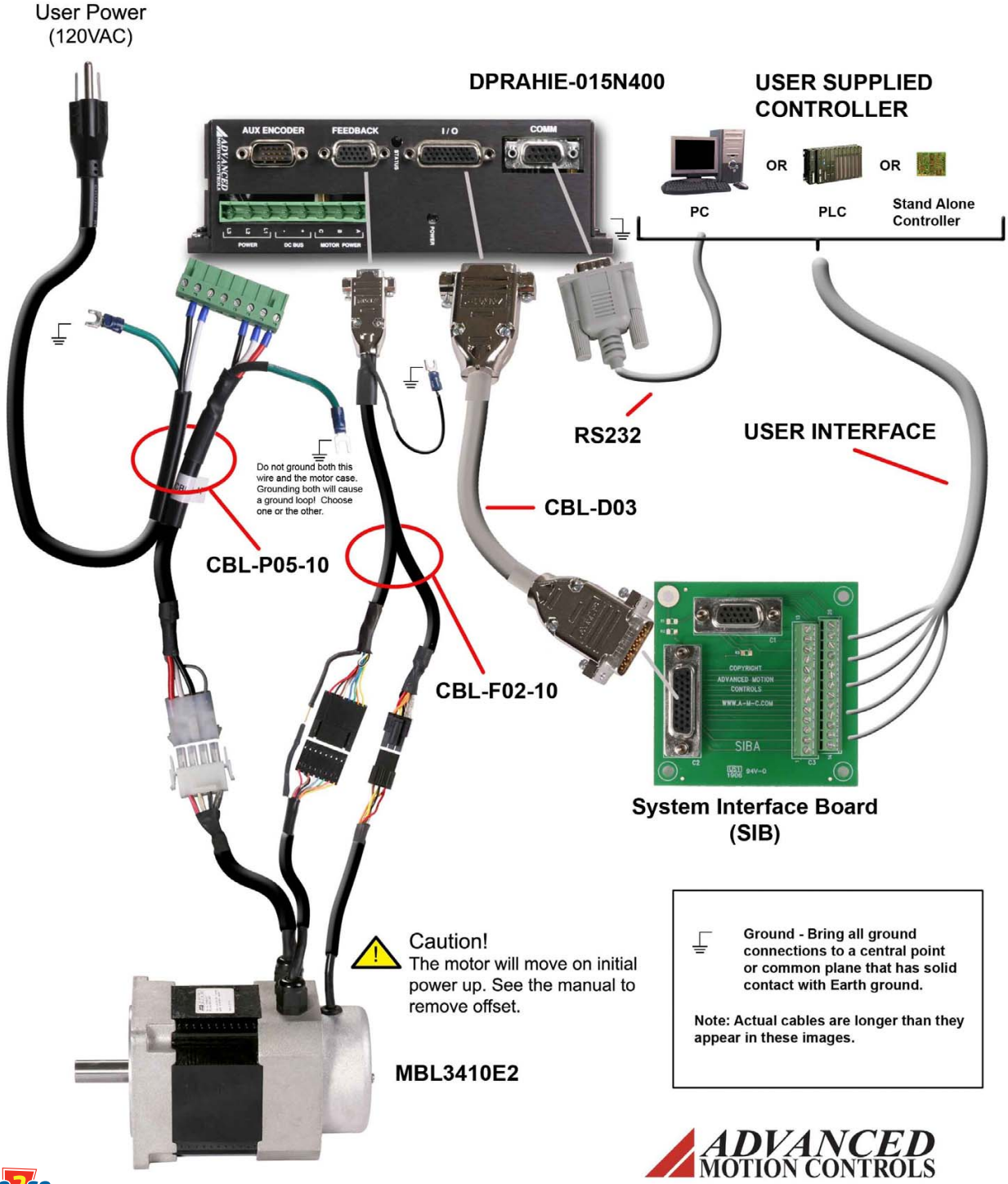
BL3410E2-D04-AC120
Cables and Connections



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Inhibit Line Test (optional) – Follow this step only if you installed the inhibit switch described in the wiring section on page 6. This is to verify that the optional inhibit switch is functioning and the drive is initially powered up in a disabled state.

1. Unplug the motor by disconnecting the white connector on CBL-P05-10. *Unplugging this connection allows you to power up the system without the possibility of spinning the motor.*
2. Apply power to the drive and your 24V supply. Toggle the inhibit switch and verify that you can cause the LED color to switch between Red and Green. Set the switch so the LED is Red.
3. Remove power and reconnect the white connector on CBL-P05-10.

System Power Up

1. Apply power to the drive. *If an inhibit switch has been installed, enable the drive by toggling the inhibit switch so the LED turns Green.*
2. The motor should turn at a slow speed.
3. If the motor turns then the system has been hooked up correctly. Remove power and continue to the next section. If not then go to **Troubleshooting**.
4. To remove the offset from the motor, follow the instructions in Section '3b Configuration' to connect to the drive and set the offset to 0.

Troubleshooting

LED not lit.	Verify that power has been applied to the drive.
Motor doesn't have holding torque	Verify that the LED is Green.
LED doesn't turn Green.	Verify all cables are connected. If an Inhibit Switch has been installed, toggle the Inhibit switch.
Motor is noisy and vibrates.	This can happen if there is noise on the feedback signal. Poor system grounding is the primary cause for excessive noise. Verify that the system is properly grounded, then cycle power.
Contact Factory - If you can't get the motor turning within a few minutes, please call and ask for technical support! 805-389-1935. We want to get you up and running quickly!	

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3a Wiring
Integrate QuickStart into your System

The following instructions are a continuation of the **5-Minute QuickStart**. This section explains controller wiring, drive configuration, drive mounting, motor mounting, SIB mounting and load coupling.

Signal Ground

Many of the Inputs and Outputs on this drive are isolated from each other. To control/read a given input/output the signal and return path must be wired correctly. This manual will explain how to wire the following signals:

- Analog Reference Input
- 24V Step & Direction Command
- Encoder Following
- Digital Inputs 1 and 2

To wire the other inputs/outputs use the block diagram on the drive datasheet to visualize the correct wiring.

Command Signal

The command signal and servo drive mode you choose are dictated by the capabilities of your controller and the desired operation of your system. Analog command signals are suited for torque and velocity modes, while digital command signals such as Step & Direction and Encoder Following are associated with Position mode.

+/-10V Command Signal (Single Ended)

Controller	SIB	Available Drive Modes
Command	C3-4 (Ref+)	Torque Mode, Velocity Mode
Signal Ground	C3-2 or C3-16 (SGND)	

To avoid ground loops there should only be one connection between the drive signal ground and the controller signal ground. Don't add a connection if there is already continuity between the two grounds.

+/-10V Command Signal (Differential)

Controller	SIB	Available Drive Modes
Command +	C3-4 (Ref+)	Torque Mode, Velocity Mode
Command -	C3-5 (Ref-)	
Signal Ground	C3-2 or C3-16 (SGND)	

To avoid ground loops there should only be one connection between the drive signal ground and the controller signal ground. Don't add a connection if there is already continuity between the two grounds.

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24V Step & Direction

Controller	SIB	Available Drive Mode
Step	C3-17 (+PDI5)	Position Mode
Direction	C3-18 (+PDI6)	
Input Common	C3-15	

Encoder Following

The Encoder Following command signals are not accessed through the SIB (System Interface Board). Rather they are accessed directly from the Auxiliary Feedback Connector labeled "Aux Encoder" on the drive.

Controller	Aux Feedback Connector on Drive	Available Drive Mode
Channel A	Pin 4 (PDI8)	Position Mode
Channel A-	Pin 5 (PDI8-)	
Channel B	Pin 6 (PDI9)	
Channel B-	Pin 7 (PDI9-)	
Signal Ground	Pin 10, 11 or 12 (SGND)	

For a single ended command signal, leave Channel A- and Channel B- disconnected.

More Information on Mode Selection

Drive modes can be separated into three basic categories: Torque, Velocity and Position. The name of the mode describes what servo loops are being closed in the drive. They don't describe the end-result of the operation. For example, a drive in Torque mode can still be in a positioning application if the external controller closes the position loop. In fact, most high performance positioning systems use a drive in torque mode with the controller closing the velocity and position loops.

The correct mode is determined by the requirements of the controller. Some controllers require that the drive be in torque mode. Other controllers require that the drive be in velocity mode. Check the documentation on your controller or contact the manufacturer of your controller to determine the correct mode for your drive.

Once the command signal and mode have been selected, connect the controller to the signals as indicated in the above tables. The proper gains and command settings must also be configured using the DriveWare Software. Software configuration is explained later in this section.

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3a Wiring
Integrate QuickStart into your System

Drive Inhibit (recommended)

The inhibit line is used to turn off power to the motor while the drive is still powered on. Sometimes this is necessary if power to the motor needs to be removed quickly or if the user needs to manually move the load in a freewheeling condition. If your controller has an inhibit function then we highly recommend that you use it.

Inhibit Connection

Controller	SIB
Inhibit	C3-11 (PDI1)
Input Common	C3-15

Note: The inhibit input is configured to disable the drive when pulled low (active low). The control logic can be inverted by setting it to active high in the DriveWare software.

Feedback

The feedback on the motor is an incremental encoder with two Channels (A and B) and an Index (I). The signals are differential but are compatible with single ended circuitry (simply leave the complimentary signals open A-, B- and I-). The resolution is 10000 counts per revolution (quadrature).

Power Requirements - Encoder power is supplied by the drive. 5VDC @ 125mA.

The screw terminals on the System Interface Board (SIB) provide easy access to the encoder signals.

Encoder connection to your controller

Signal	SIB
Channel A+	C3-20
Channel A-	C3-21
Channel B+	C3-22
Channel B-	C3-23
Channel I+	C3-24
Channel I-	C3-25

To properly detect the encoder signals, the Signal Grounds on the servo drive and controller need to be connected.

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3a Wiring
Integrate QuickStart into your System

Drive Mounting
Mounting Dimensions can be found in the drive datasheet in the Appendix.

The drive can be mounted flat against the base plate or along the spine.

Mounting the drive flat on the base plate against a large thermally conductive surface for cooling will provide the most natural heat dissipation for the drive. A metal back plane in a cabinet on the machine often makes a good surface.

Drives mounted on the spine can be mounted next to each other. Maintain a minimum separation of 1 inch between drives to provide adequate convection cooling.

Note: Additional cooling may be necessary to dissipate the heat generated by the drive depending on the ambient temperature, duty cycle and natural ventilation.

Motor Mounting
Mounting Dimensions can be found in the motor datasheet in the Appendix.

The mounting surface must be stiff enough so it does not deflect when radial loads are applied to the motor shaft. The mounting surface should also have good thermal conductivity, especially if peak performance is demanded of the motor.

SIB Mounting
Mounting Dimensions can be found in the SIB datasheet in the Appendix.

The SIB can be mounted using the mounting holes or a DIN tray such as from Phoenix Contact. If using the mounting holes, standoffs must be used to keep the bottom of the SIB from shorting with the mounting surface.

Cable Routing
Cable Datasheets can be found in the Appendix.

QuickStart cables come with excellent shielding and make proper grounding easy. This makes proper cable routing less critical, however proper routing practices should still be followed.

Route cables to minimize length and minimize exposure to noise sources. The motor power wires are a major source of noise and the motor feedback wires are susceptible to receiving noise. This is why it is never a good practice to route the motor power wires close to the motor feedback wires even if they are shielded. Although both of these cables originate at the amplifier and terminate at the motor, try to find separate paths that maintain distance between the two. A rule of thumb for the minimum distance between these wires is 1cm for every 1m of cable length.

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3a Wiring
Integrate QuickStart into your System

Grounding

Bring all ground wires to a central point ground such as a ground bus, ground plane or a single ground bolt. Also don't forget to ground the drive chassis! Use the silver screw marked PE on the case.

Motor Ground – The green wire coming from motor power cable is the motor chassis ground. If the motor case is already grounded through direct contact with the machine housing, then leave the green wire disconnected. Grounding the motor at both the green wire and at the motor case causes a ground loop that has been shown to disrupt the feedback signals. Choose one or the other.

Grounding the motor case directly rather than through the green grounding wire results in better noise reduction.

Load Coupling

A non-rigid coupling must be used between the motor shaft and the load to minimize mechanical stress due to radial loads, axial loads or misalignment. If you feel that the radial load on the motor is excessive, you may want to consider connecting the motor to an idler shaft that is supported by pillow block bearings (or similar). Then the load can be coupled to the idler shaft without risking damage to the motor bearings.

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Configuration / Software

Advanced Motion Controls DP Series DigiFlex® Servo Drives are configured using the DriveWare configuration software. DriveWare can be found on the CD ROM that came with your QuickStart package or it can be downloaded from the Advanced Motion Controls website at http://www.a-m-c.com/content/support/categories/dprs232.html.

The basic setup of DigiFlex® servo drives is designed to be user friendly. These instructions will walk you through the steps necessary to configure your drive to your system:

- Connect to the drive
- Configure the drive mode.
    - Torque
    - Velocity
        - Set Velocity Limits
    - Position
        - Set Position Limits

Save your project often to the DriveWare\My Projects directory.
For topics not covered in this guide, assistance is available through any of the following:

- DriveWare Help files
- www.a-m-c.com
- Technical Assistance via phone: 805-389-1935

Technical Assistance via e-mail: techsupport@a-m-c.com.

Note: Complete software documentation can be found on the Advanced Motion Controls website under 'Support / DigiFlex Performance Series – RS232 / RS485'.

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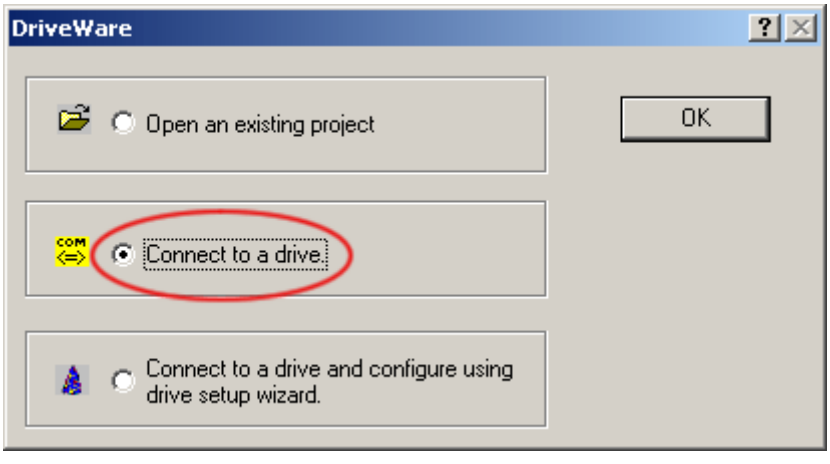
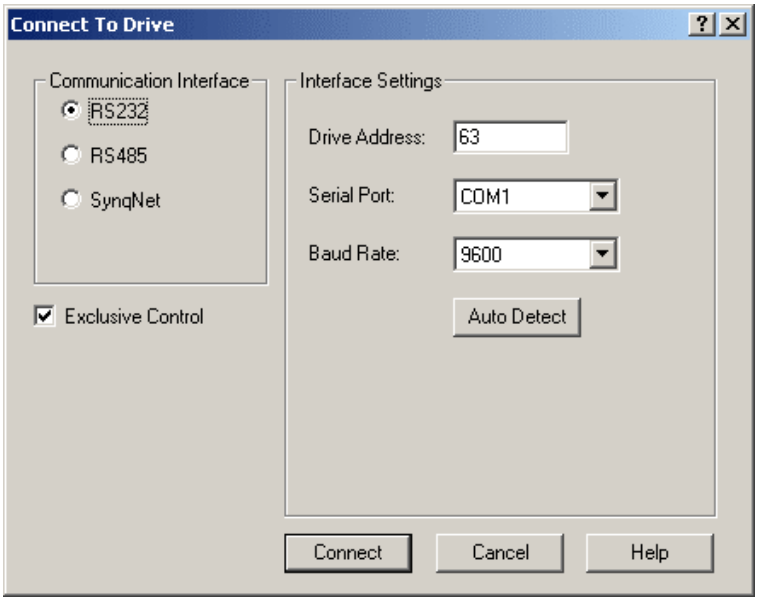
3b Configuration
Integrate QuickStart into your System

Connect to the Drive

1. Install the AMC DriveWare software onto your PC. Follow instructions to assure complete installation.
2. Connect an available RS-232 communications port on your PC to the serial interface on the drive. Use the cable provided with your QuickStart system.
3. If desired, connect the Inhibit/Enable circuit as described in the QuickStart User Manual.
4. Apply power to the drive.
5. Launch DriveWare to start the setup software.
6. At the opening screen, select *Connect to a drive* and click "OK".



7. Use the default settings (COM1, 9600),
   Note: If this doesn't work, select *Auto Detect*, then *Start Scan….* Once the drive is found select *Apply Settings* then *Connect*.



8. You are now connected to the drive. The status indicator on the bottom right corner of the screen should indicate "CONNECTED."

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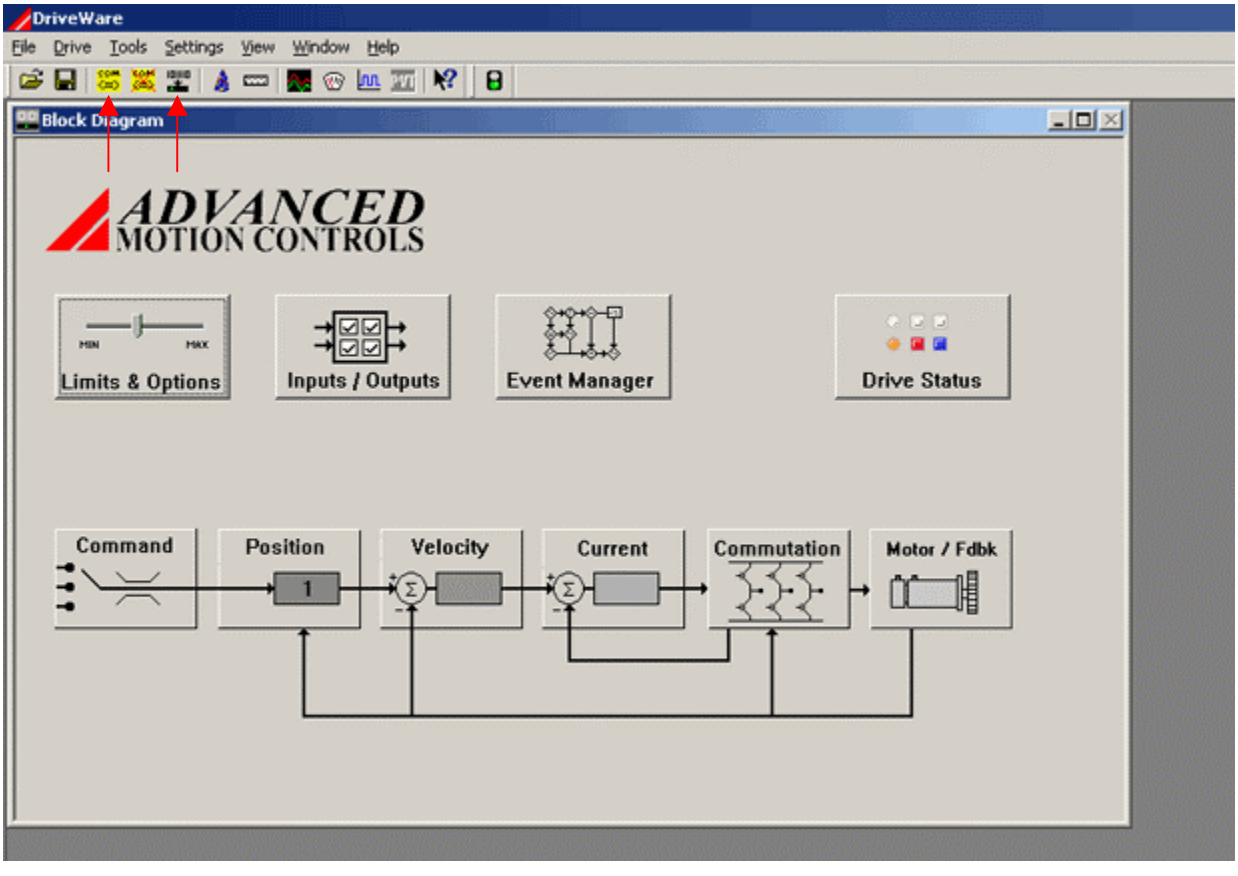
8. For the best performance when running network intensive applications such as the real time oscilloscope, you should increase to the highest baud rate available for your system. To change the RS-232 communications baud rate, you must first be connected to the drive, then follow these steps:
   a. On the Menu bar, select *Communication* → *Connect* (or click the *Connection Settings* icon)
   b. Select the new baud rate.
   c. Click *OK* to set the new baud rate.
   d. To save the settings in the drive select *Drive* → *Store to drive* (or click the *Store Settings* icon), then OK to store parameters to the drive nonvolatile memory.

Note: Some PC's may not communicate reliably at higher baud rates. If increasing the communications baud rate results in communications errors, use a lower rate.



The Block Diagram window gives access to the servo drives' setup parameters.

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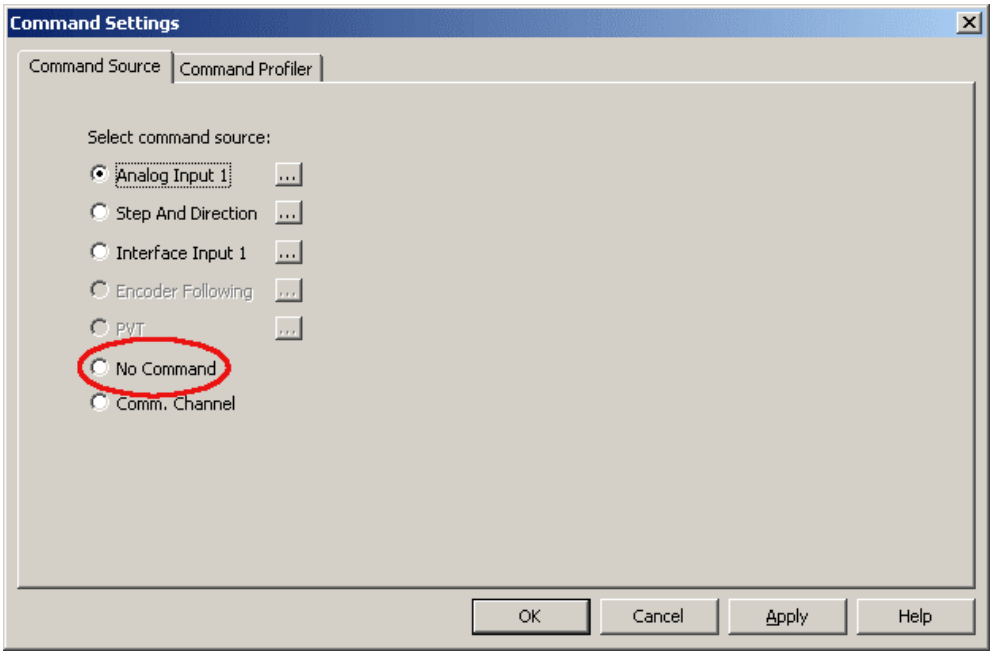
Drive Mode Configuration

The drive has been configured with an offset to make the motor turn without a command. Before you configure the drive, remove the offset so the motor doesn't keep turning.

In the Block Diagram, select the *Command* block.

1. Select No Command



2. Click *OK* on the Command Source window.

Note: *No Command* is a non-operation input source that prevents sudden motion. If the drive is in velocity or current mode, *No Command* will always provide a command of zero. If the drive is in position mode, *No Command* sets Position Target equal to the Position Measured.

Enable / Disable

The drive can be enabled and disabled by clicking the *Enable/Disable* icon in the toolbar . If you are using an external inhibit switch, the icon cannot override it. In this case to enable, both the switch AND the Enable/Disable icon need to be set to Enable .

You are now ready to configure the drive for your system:

Torque Mode
Page 18

Velocity Mode
Page 22

Position Mode
The Velocity loop must be tuned first, Page 22. Then the drive can be set in Position Mode, Page 30.

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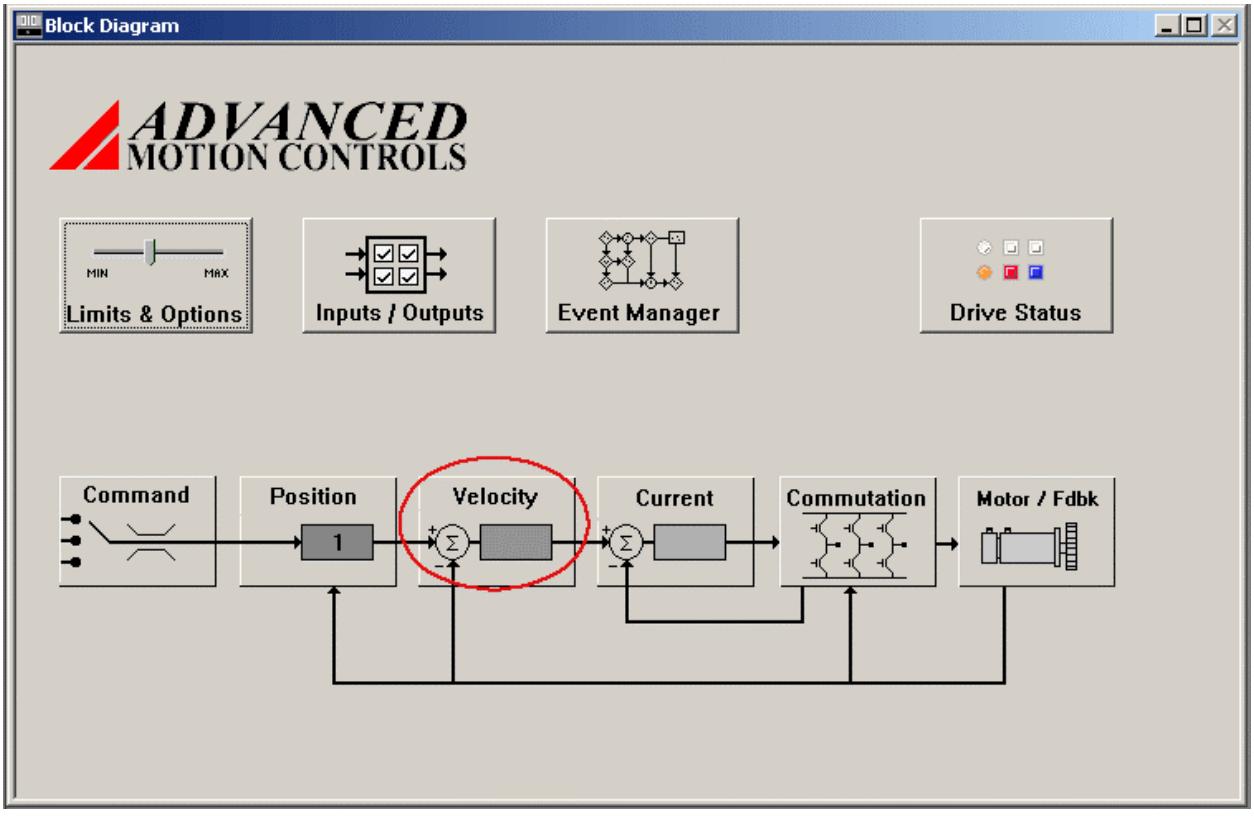
Torque Mode

Your QuickStart drive has been configured in Velocity mode. To change to torque mode simply disable the Velocity loop.

1. In the block diagram, click on the Velocity Loop block.



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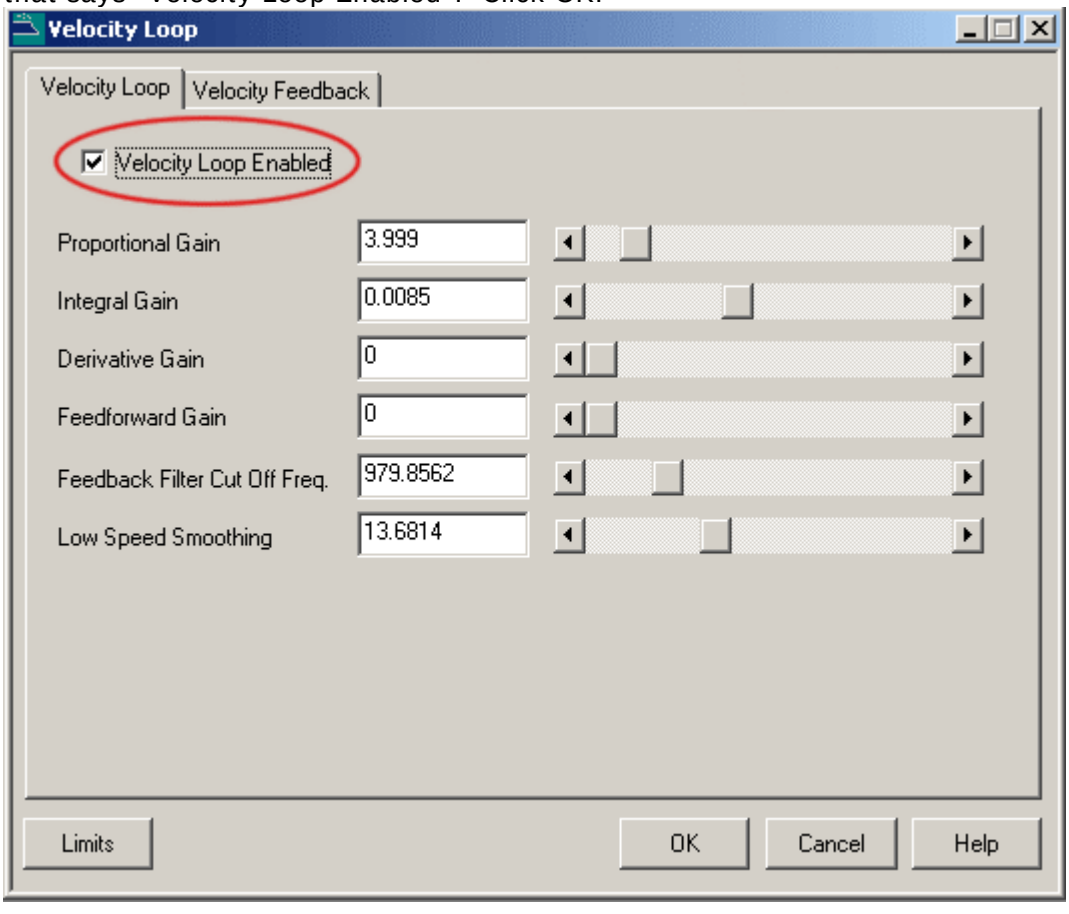
2. This opens the Velocity Loop screen. To disable the velocity loop, uncheck the box that says “Velocity Loop Enabled”. Click OK.



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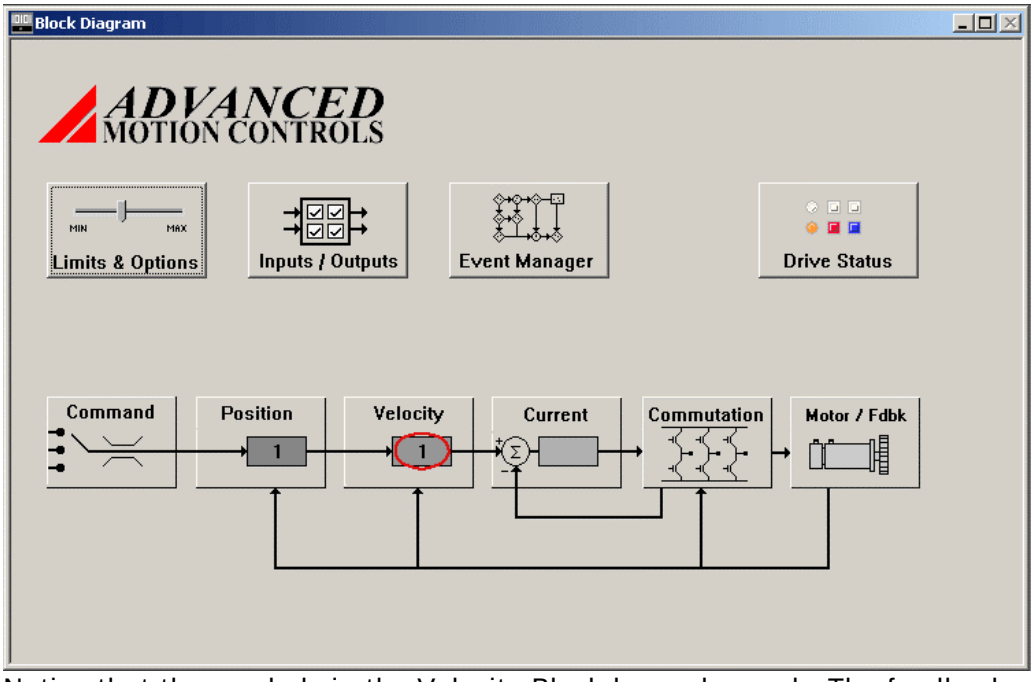
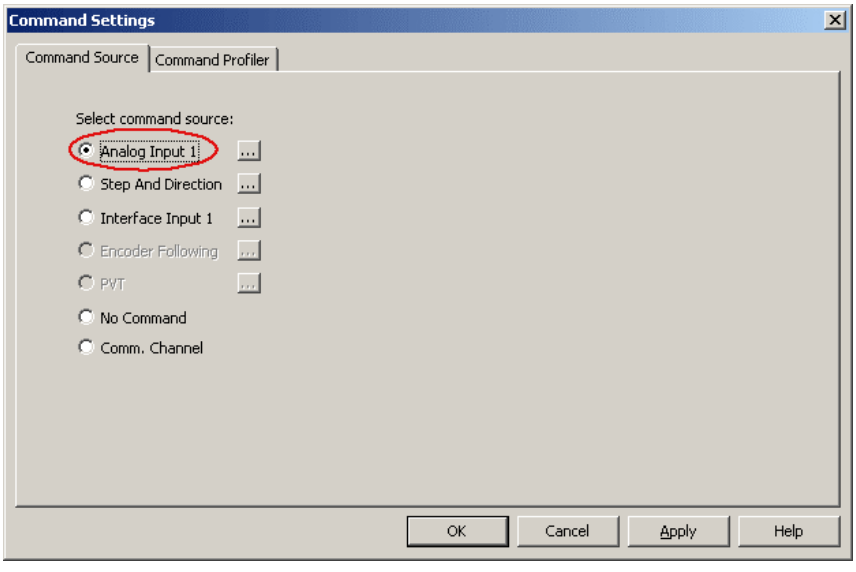


Notice that the symbols in the Velocity Block have changed. The feedback arrows no longer extend into the block and the "1" indicates that the velocity loop is disabled and is set to unity gain.

Command Source Selection for Torque Mode

In the Block Diagram window, select the *Command Source* block.



1. Select Analog Input 1
2. Click *OK*.

Note: *No Command* is a non-operation input source that prevents sudden motion. If the drive is in velocity or current mode, *No Command* will always provide a command of zero. If the drive is in position mode, *No Command* sets Position Target equal to the Position Measured.

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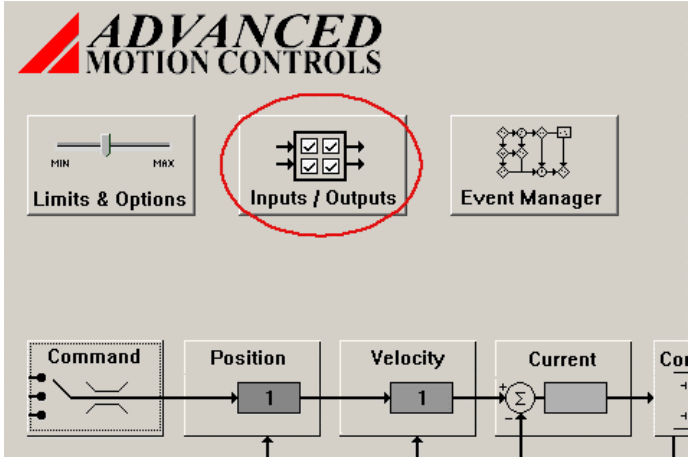
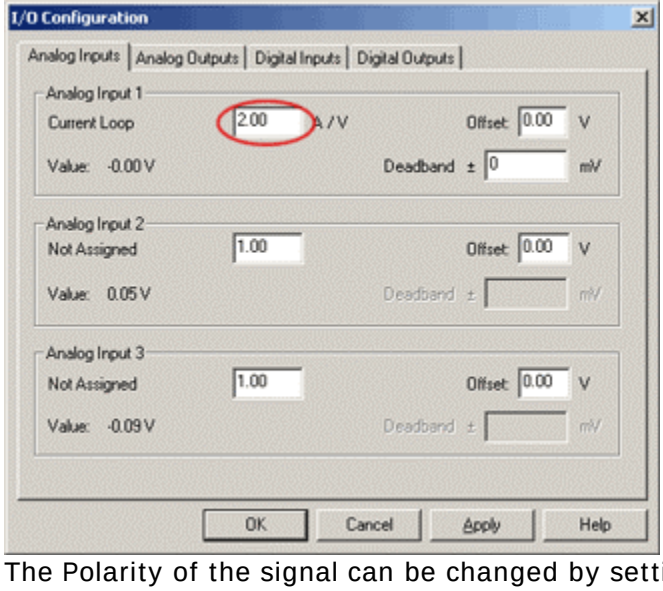
Analog Input Scaling

1. Set the analog command scaling as follows:
   a. In the Block Diagram window, select *Inputs/Outputs*.



   b. Set the desired scaling (e.g. Amps/Volt) for Analog Input 1.



   The Polarity of the signal can be changed by setting the scaling value to a negative number. The offset voltage and deadband can also be set from this screen.
   c. Click *Apply* or *OK* to set any modified values.
2. On the Menu Bar, select *Drive* → *Store to drive* (or click the *Store Settings* icon), then OK to store parameters to the drive nonvolatile memory.
3. The Analog Input may now be used to apply a current command to the drive.

Further assistance is available through any of the following:

DriveWare Help files
www.a-m-c.com
Technical Assistance via phone: 805-389-1935
Technical Assistance via e-mail: techsupport@a-m-c.com.

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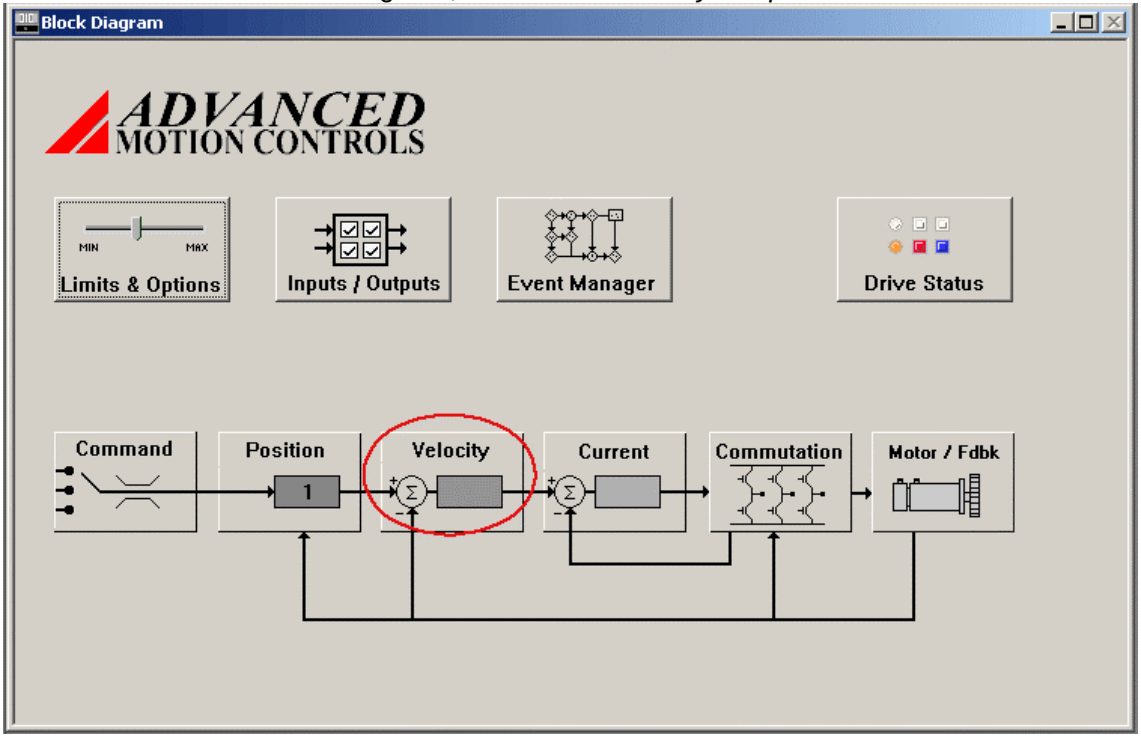
Velocity Mode

Your QuickStart drive is already in Velocity Mode, however the velocity loop has been tuned for the unloaded motor.

Velocity Loop tuning is dependent on the system mechanics and inertia, therefore for best performance; the Velocity Loop must be tuned with the motor installed in the system and coupled to the load.

Velocity Loop Tuning

1. Verify that the drive is disabled ( ).
2. From the Main Block Diagram, select the *Velocity Loop* block.



3. In the *Velocity Loop* window, click the *Limits* button to open the *Velocity Limits* tab in *Limits & Options*.

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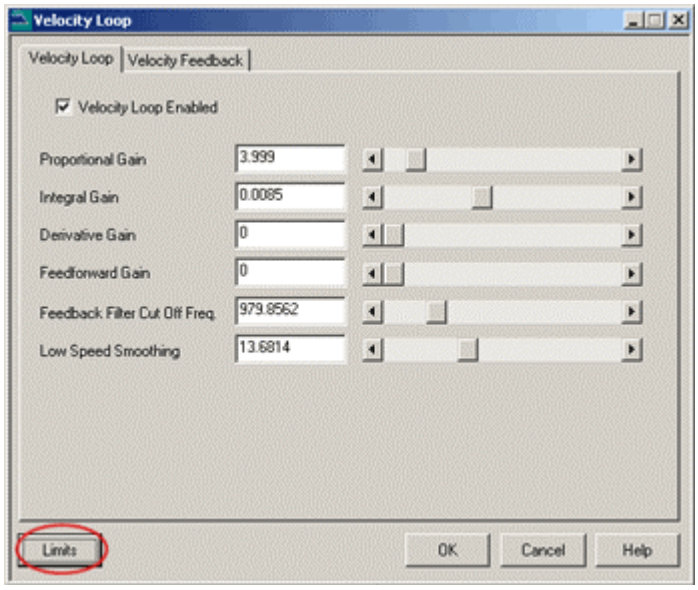
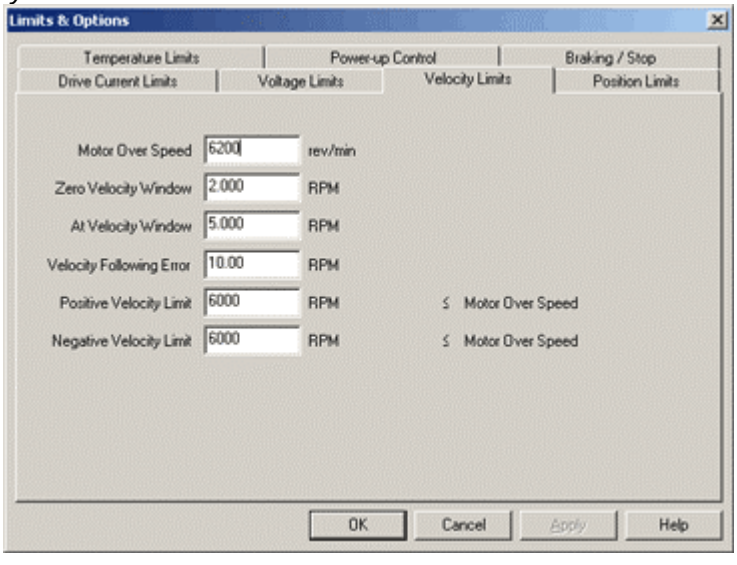


4. The limits have been preset to the maximum capabilities of the motor/servo drive system. If you wish, lower values can be set to match your machine requirements. Set values for *At Velocity Window*, *Velocity Following Error*, *Positive Velocity Limit*, and *Negative Velocity Limit*.



Note: Velocity limit values cannot exceed the Maximum Speed rating of the motor (from the Motor Data window).

5. Click “OK” to accept values and close *Limits & Options*.

6. Open the *Waveform Generator* by clicking the Waveform Generator button.

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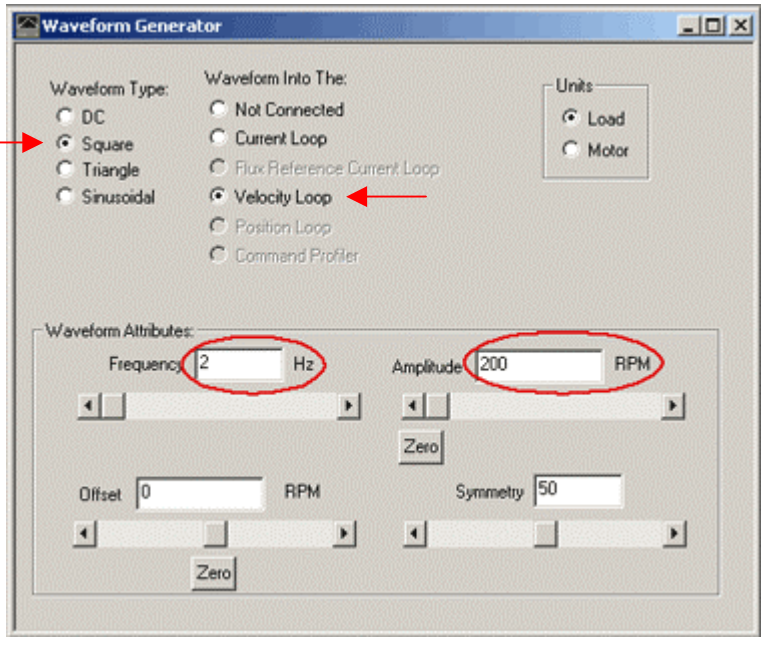
3b Configuration (Velocity Mode)
Integrate QuickStart into your System



7. With the Waveform Generator, establish a *Square* wave into the *Velocity Loop* with an amplitude of approximately 10% of the expected motor speed during system operation. Set the *Frequency* low enough so the motor has enough time to reach the commanded velocity, but high enough to prevent the system from reaching any mechanical limits on the machine (e.g.: 1-3Hz).
   Note: The accuracy of velocity loop tuning is dependent on the quality and resolution of the velocity feedback. Sources with relatively low resolution or higher noise will require tuning at a higher velocity in order to overcome the effects of these limitations. It is best to experimentally determine the optimum tuning setup.
8. To open the digital oscilloscope, select Tools → Oscilloscope (or click the Oscilloscope icon .) Use the help files in the DriveWare software for detailed instructions on how to use the oscilloscope. In the menu bar go to *Help* → *AMC DriveWare Help* → *Help* → *Help Index* → *Use the digital scope*.

Set up the oscilloscope as follows:

   a. Set *Motor Velocity Target* to channel 1 and the *Motor Velocity Measured* to channel 2.
   b. Set the *Trigger Source* to *Motor Velocity Target* at a level of zero RPM, Up Slope.

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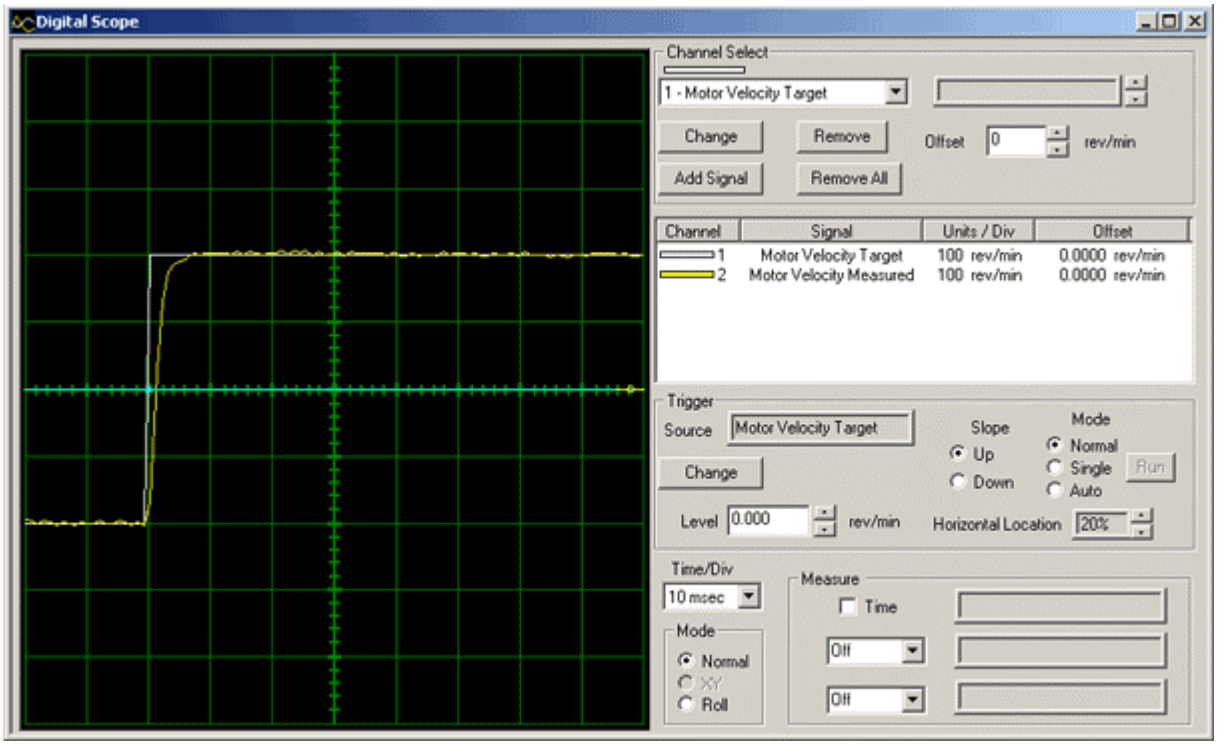
9. To keep the signal from jumping around, set the Trigger Mode to *Normal.*
10. Enable the drive by clicking the *Enable/Disable Drive* icon .



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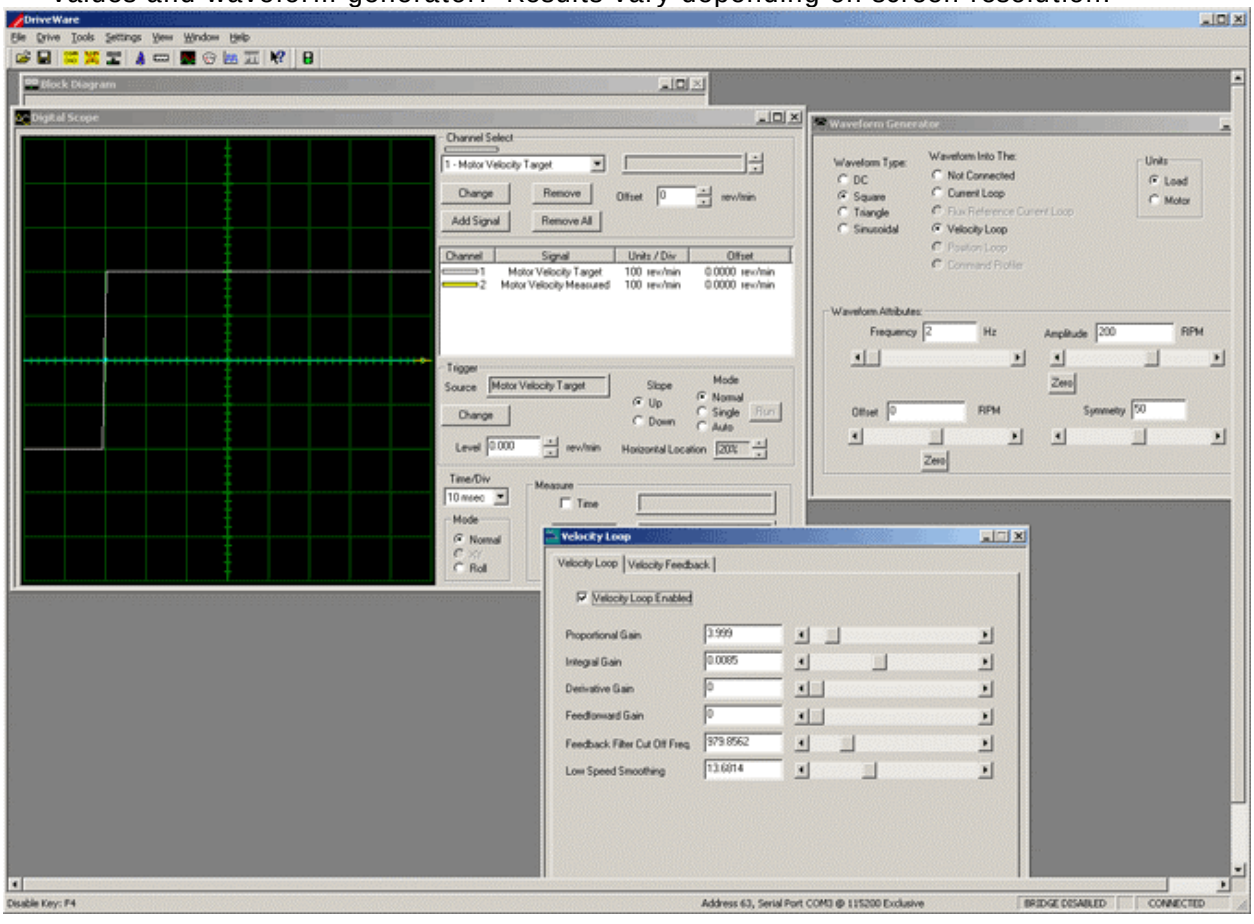
11. The desktop should be arranged so the oscilloscope is visible while adjusting the tuning values and waveform generator. Results vary depending on screen resolution.



12. Use the *Proportional Gain and Integral Gain* sliders or arrow buttons to adjust the *Motor Velocity Measured* waveform on the oscilloscope and match the *Motor Velocity Target* as closely as possible. The *Feedback Filter Cut Off Frequency* can be used to smooth the response.
13. When tuning is complete, disable the drive with the *Enable/Disable Drive* icon and select *Not Connected* on the Waveform Generator.
14. On the Menu Bar, select *Drive* → *Store to Drive* (or click the *Store Settings* icon), then OK to store parameters to the drive nonvolatile memory.

*****Note the Velocity Loop is now sufficiently tuned. For Position Mode applications proceed to Position Mode configuration page 30.**

For Velocity Mode applications continue onto the next page to configure the command source.

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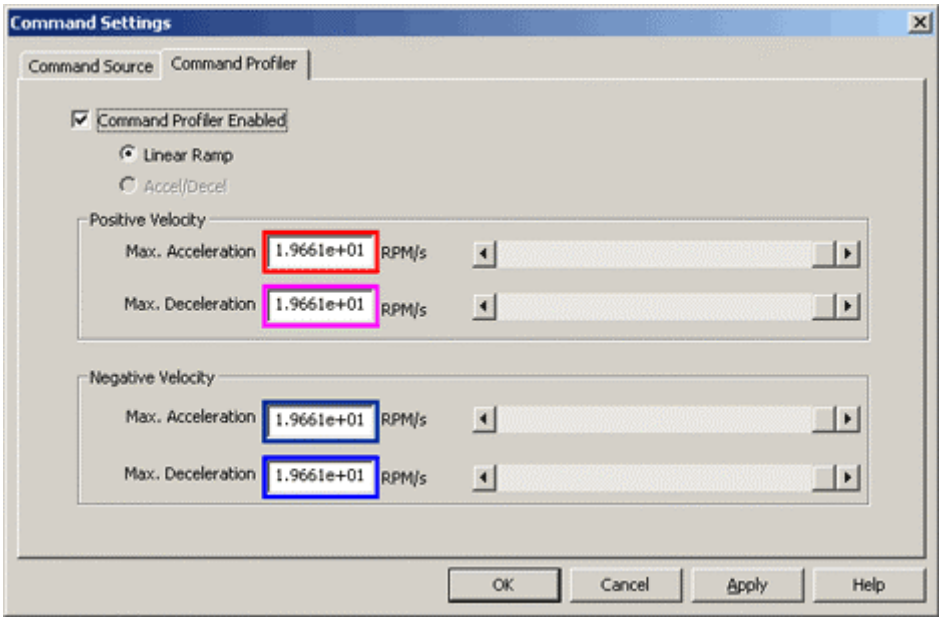
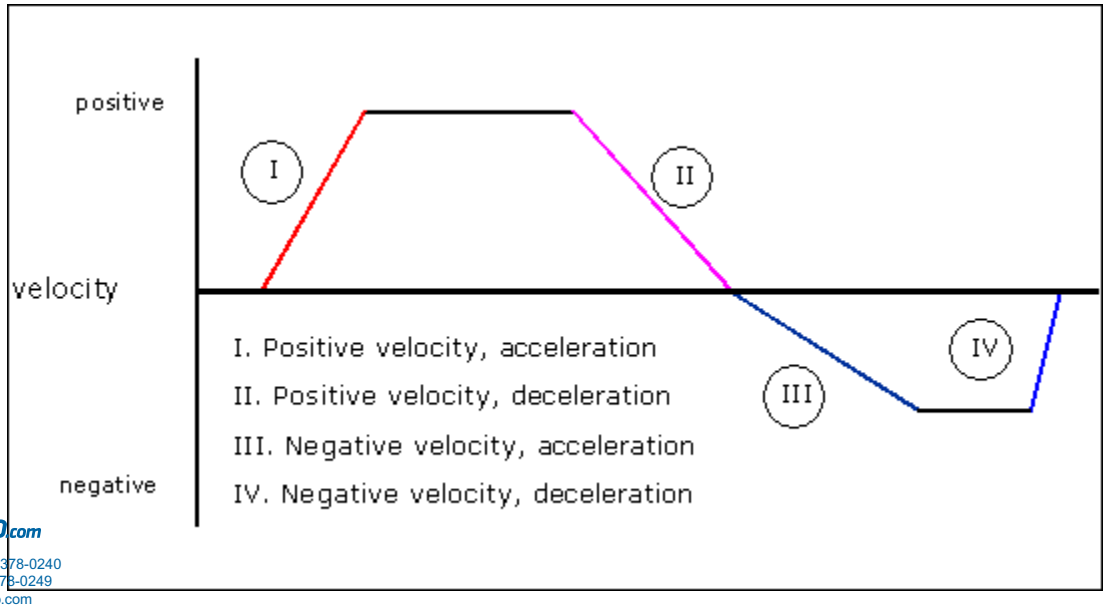
Velocity Loop Command Profiling (Optional)

The command profiler can be used to limit the acceleration and deceleration from step input commands. The command profiler provides independent control of acceleration and deceleration in both the positive and negative velocity directions.

1. From the Main Block Diagram, open the *Command* block.



2. Activate the check box for *Command Profiler Enabled*.
3. Using the slider bars or numerical entry, enter the desired acceleration values. Independent values can be entered for both acceleration and deceleration in both the positive and negative directions. Click *OK* when done.



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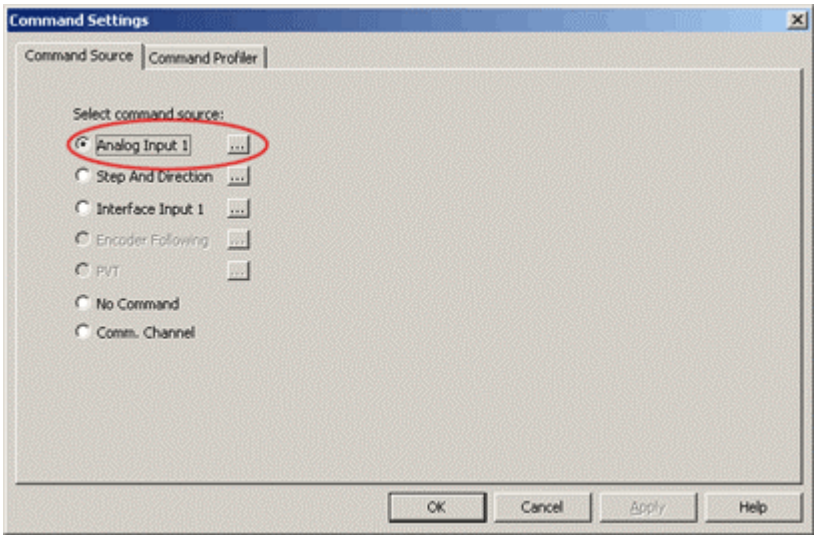
Command Source Selection

1. In the Block Diagram window, select the *Command* block.



2. Select Analog Input 1. Click *OK* to accept the selection and close the window.

Note: *No Command* is designed to be a non-operation input source. If the drive is in velocity or current mode, *No Command* will always provide a command of zero.

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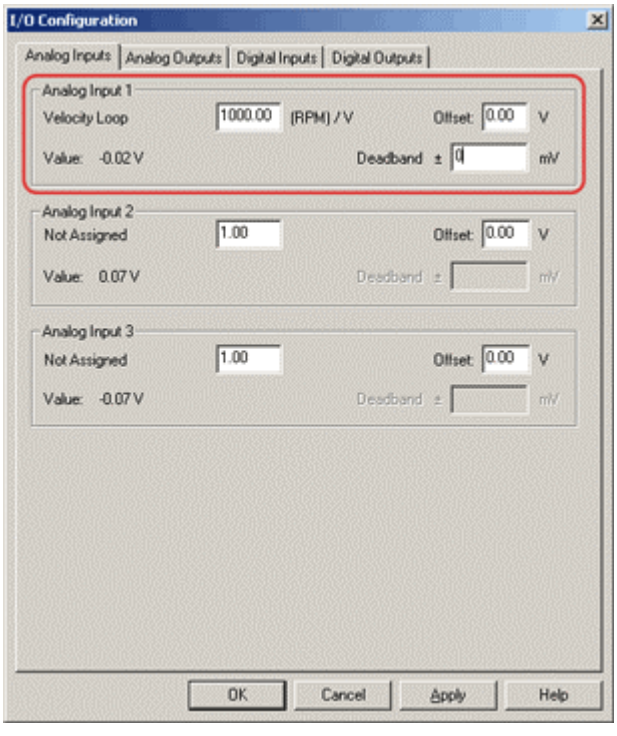
Analog Input Scaling

1. Set the analog command scaling as follows:
    a. In the Block Diagram window, select the *Inputs/Outputs block*.
    b. For the appropriate Analog Input, (as previously selected,) set the required scaling (e.g. RPM/Volt). If desired, an offset or deadband can also be applied from this screen.
    c. Command polarity can be inverted by changing the sign (+/-) on the Analog Input scaling.
    d. Click *Apply* or *OK* to set any modified values.
    e. On the Menu Bar, select *Drive* → *Store to drive* (or click the *Store Settings* icon), then OK to store parameters to the servo drive.
2. The Analog Input is now configured and can be used to apply a velocity command to the drive.



Further assistance is available through any of the following:

- DriveWare Help files
- www.a-m-c.com
- Technical Assistance via phone: 805-389-1935
- Technical Assistance via e-mail: techsupport@a-m-c.com.

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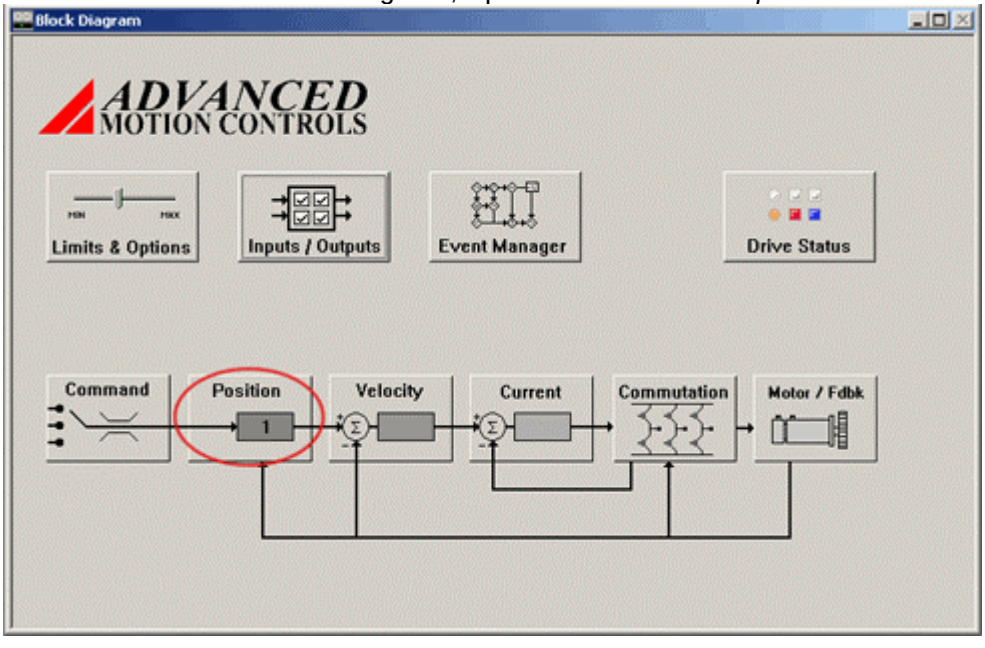
Position Mode

Before the servo drive can be configured in Position Mode, the Velocity Loop must be tuned to match the system. Follow the instructions for Velocity Mode configuration first.

Position Loop tuning is dependent on the system mechanics and inertia, therefore for best performance; the Position Loop must be tuned with the motor installed in the system and coupled to the load.

1. Verify that the drive is disabled ( ).
2. From the Main Block Diagram, open the *Position Loop* window.



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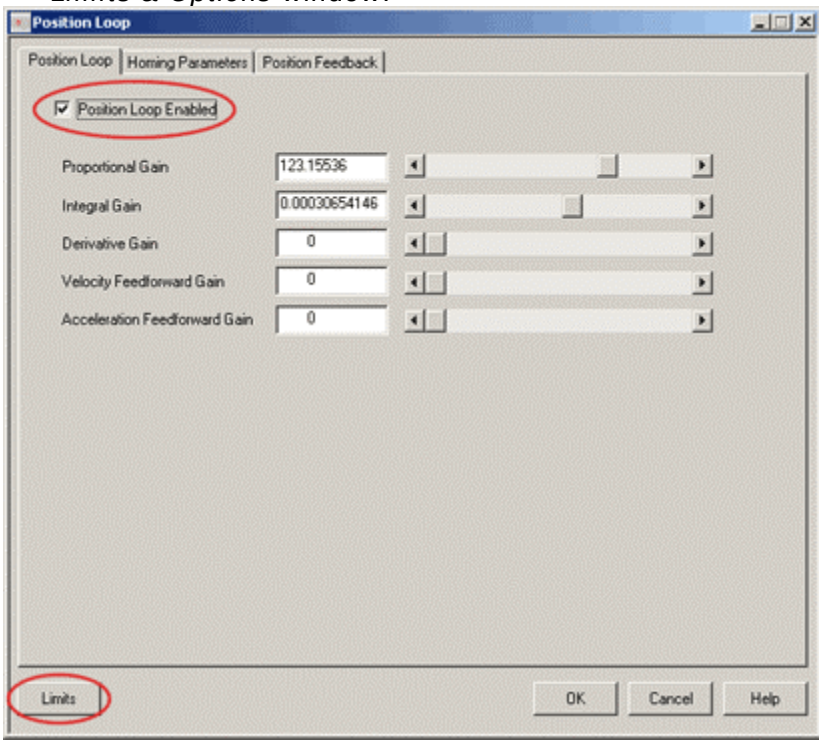
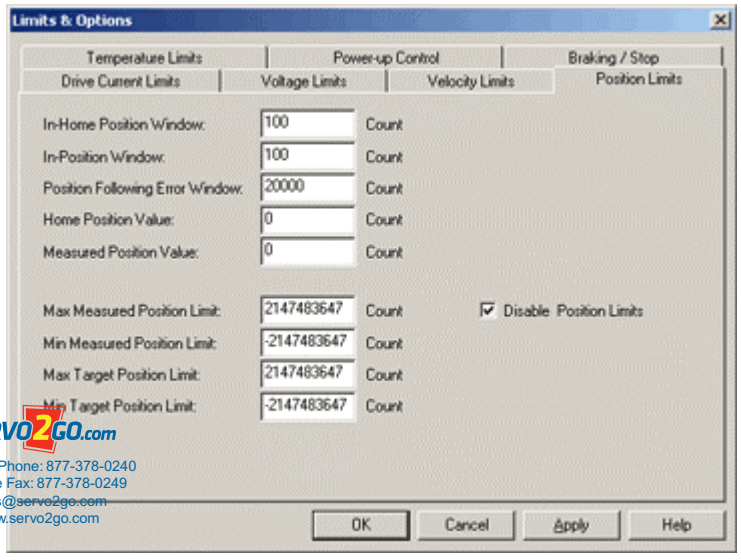
3. Select the check box for *Position Loop Enabled*.

4. In the *Position Loop* window, click the *Limits* button to open the *Position Limits* tab in the *Limits & Options* window.



5. Enter values for *In Position Window* and *Position Following Error Window*. To prevent the drive from unintentionally disabling, the *Position Following Error Window* has been preconfigured to a large value equivalent to two motor revolutions. The value can be reduced to meet your system requirements, but if it is set too small, you may have difficulty enabling the drive if the motor is out of position.



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6. If appropriate for your machine, enter values for the *Max and Min Target Position Limit*, or leave the limits disabled.

7. Set the *Measured Position Value* to *zero* (0) counts.

8. Click “OK” to accept values and close *Limits & Options*.

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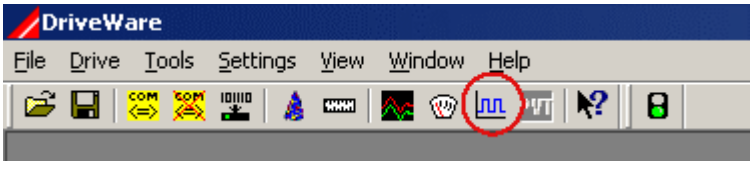
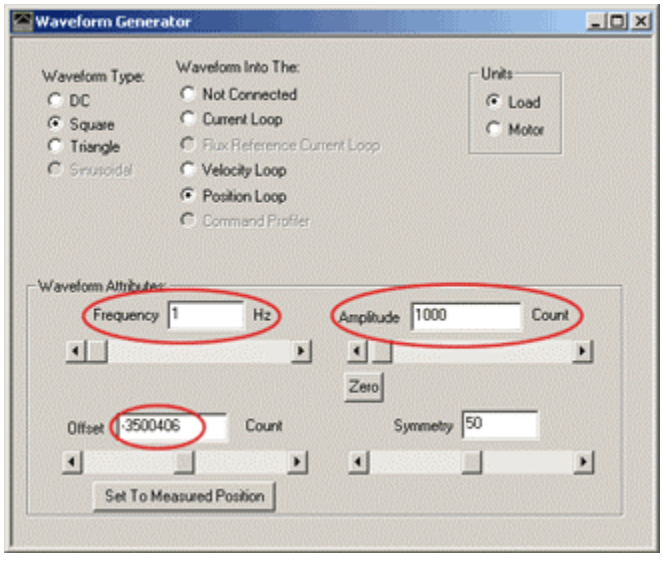
3b Configuration (Position Mode)
Integrate QuickStart into your System

Note: The drive has been configured to disable due to a following error if the Measured Position doesn't match the Target Position. A large following error is likely if you have been running the motor in Velocity mode and then switched to Position mode. For your convenience, Digital Input 2 (pin 12 on the SIB) has been configured to set the Measured Position equal to 0. To set the Measured Position to zero, briefly pull Digital Input 2 to signal ground. A switch or push button can be wired here for convenience.

9. Open the Waveform Generator.



10. With the drive still disabled, use the Waveform Generator to establish a *Square* wave into the *Position Loop* with amplitude of 1000 to 1500 counts. The frequency should be slow enough to allow the motor to settle into position (e.g. 1-2Hz). Decimal values for the frequency can be set for very heavy machines.



If the waveform generator shows a large offset, use Digital Input 2 to set the measured position to 0 (briefly pull pin 12 to pin 2 on the SIB). Then click the "Set To Measured Position" button. The offset should now read "0".

Continued…

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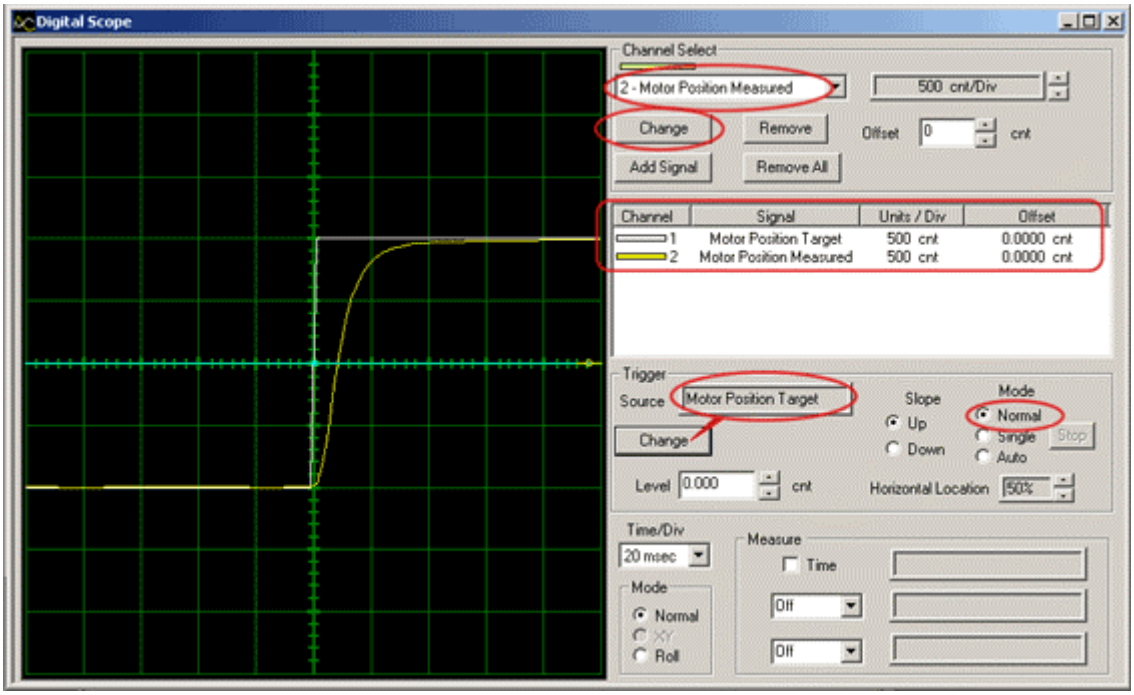
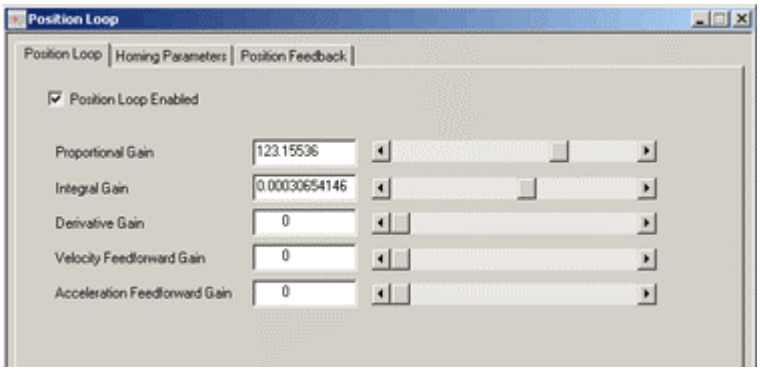
3b Configuration (Position Mode)
Integrate QuickStart into your System

11. Open the oscilloscope and set it up as follows:
    a. Set Channel 1 to *Motor Position Target* and Channel 2 to *Motor Position Measured*. Set the scaling on these channels to 500 counts/div.
    b. In the *Trigger* area of the scope, use the *Change* button to set *Motor Position Target* as the Trigger Source at a level of zero Counts, Up Slope.
12. Set the Trigger Mode to *Normal*. Change the Time/Div to 20msec.



13. Enable the drive by clicking the *Enable/Disable Drive* icon .
14. Use the *Proportional Gain* and *Integral Gain* sliders to adjust the *Position Measured* waveform on the oscilloscope to achieve the desired response. Use the arrow buttons for fine-tuning. Take care not to 'over-tune' the system. This can result in excessive vibration and audible noise.



15. When tuning is complete, disable the drive and select *Not Connected* on the Waveform Generator. Close the Waveform Generator, Oscilloscope and Position Loop screen.
16. On the Menu Bar, select *Drive* → *Store* to drive (or click the *Store Settings* icon), then OK to store parameters to the drive nonvolatile memory.

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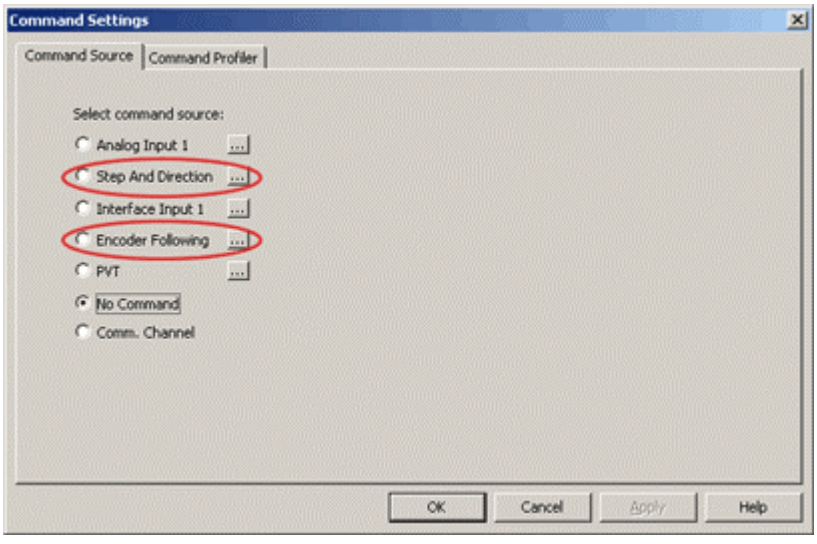
3b Configuration (Position Mode)
Integrate QuickStart into your System

Command Source Selection

1. In the Block Diagram window, select the *Command* block.



2. Select the command source appropriate for your system. *Step and Direction* and *Encoder Following* are the easiest to set up for position mode.
3. Accesses additional parameters by clicking the ellipsis button ..., set the step and direction or encoder following scaling.
4. Click *OK* on the Command Source window.

Note: *No Command* is designed to be a non-operation input source. If the drive is in velocity or current mode, *No Command* will always provide a command of zero. If the drive is in position mode, when the command is set to *No Command* the drive sets *Position Target* equal to the *Position Measured* to prevent sudden motion.

Further assistance is available through any of the following:

- DriveWare Help files
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- Technical Assistance via e-mail: techsupport@a-m-c.com.

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4
Going into Production

Prototype to Production

Once you have completed your proof of concept you will be ready to design for production. If you decide that the QuickStart drive and motor are perfect for you then you're in luck. Both are popular off-the-shelf items that are readily available. Drives can be ordered directly from us and we can put you in touch with the appropriate motor supplier.

If your servo system requires a drive that better fits your application such as:

- Additional features
- Different power range
- Smaller size
- Different form factor such as 'plug in' style drives
- Network connectivity

Then an *ADVANCED* Motion Controls applications engineer can help optimize your system by selecting the best drive for your needs.

Our local representatives can also help you with the selection of motors and other system components such as cables, gear boxes, slides, bearings and more.

Feedback

Your feedback is important to us. Your comments can make QuickStart better and help us improve our processes, technical support, customer support and product offering. Please go to www.a-m-c.com and select Contact Us.

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5
Appendix

A. System Specifications

B. Drive

C. Motor

D. Cables

E. System Interface Board

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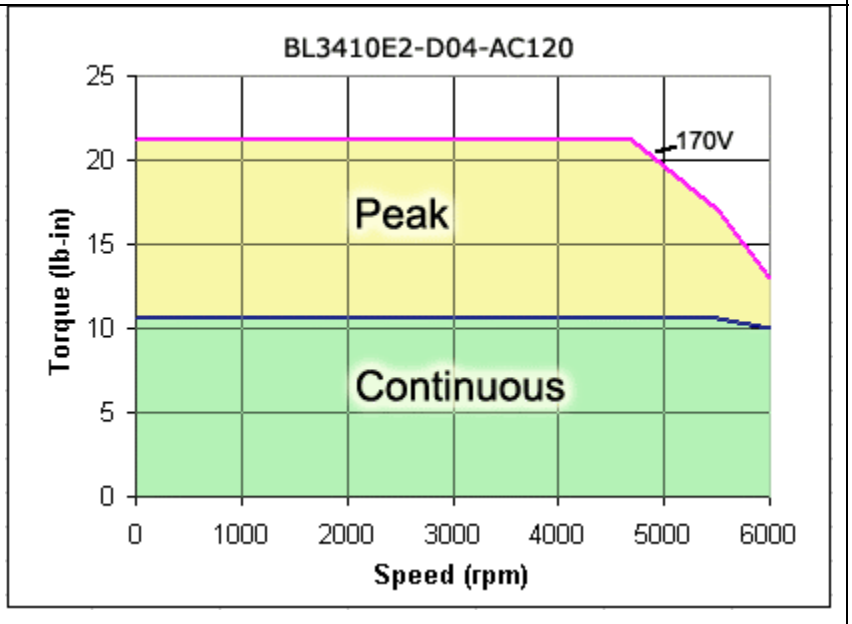
System Specifications

Torque – peak	21.1 lb-in, 2.38 Nm
Torque – continuous	10.57 lb-in, 1.19 Nm
Velocity Maximum	6000 rpm
Supply Voltage	120VAC
Encoder Resolution	10000 counts / rev
Speed Torque Curve	

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ADVANCED MOTION CONTROLS DigiFlex® Performance™ Servo Drive **DPRAHIE-015N400**

Description

The DigiFlex® Performance™ (DP) Series digital servo drives are designed to drive brushed and brushless servomotors. These fully digital drives operate in torque, velocity, or position mode and employ Space Vector Modulation (SVM), which results in higher bus voltage utilization and reduced heat dissipation compared to traditional PWM. The command source can be generated internally or can be supplied externally. In addition to motor control, these drives feature dedicated and programmable digital and analog inputs and outputs to enhance interfacing with external controllers and devices.

This DP Series drive features a single RS-232/RS-485 interface used for drive configuration and setup. Drive commissioning is accomplished using DriveWare, available at www.a-m-c.com.

All drive and motor parameters are stored in non-volatile memory.

Power Range

Peak Current	15 A (10.6 A_{RMS})
Continuous Current	7.5 A (5.3 A_{RMS})
Supply Voltage	90 - 264 VAC

Features

- Four quadrant regenerative operation
- Space vector modulation (SVM) technology
- Fully digital state-of-the-art design
- Programmable gain settings
- Fully configurable current, voltage, velocity and position limits
- PIDF velocity loop
- PID + FF position loop
- Compact size, high power density
- 16-bit analog to digital hardware

MODES OF OPERATION
- Current
- Position
- Velocity

COMMAND SOURCE
- Encoder Following
- ±10 V Analog
- 24 V Step & Direction

FEEDBACK SUPPORTED
- Halls
- Incremental Encoder
- ±10 V Analog
- Auxiliary Incremental Encoder

INPUTS/OUTPUTS
- 3 High Speed Captures
- 4 Programmable Analog Inputs (16-bit/12-bit Resolution)
- 3 Programmable Digital Inputs (Differential)
- 7 Programmable Digital Inputs (Single-Ended)
- 4 Programmable Digital Outputs (Single-Ended)

COMPLIANCES & AGENCY APPROVALS
- RoHS
- UL/cUL Pending
- CE Pending

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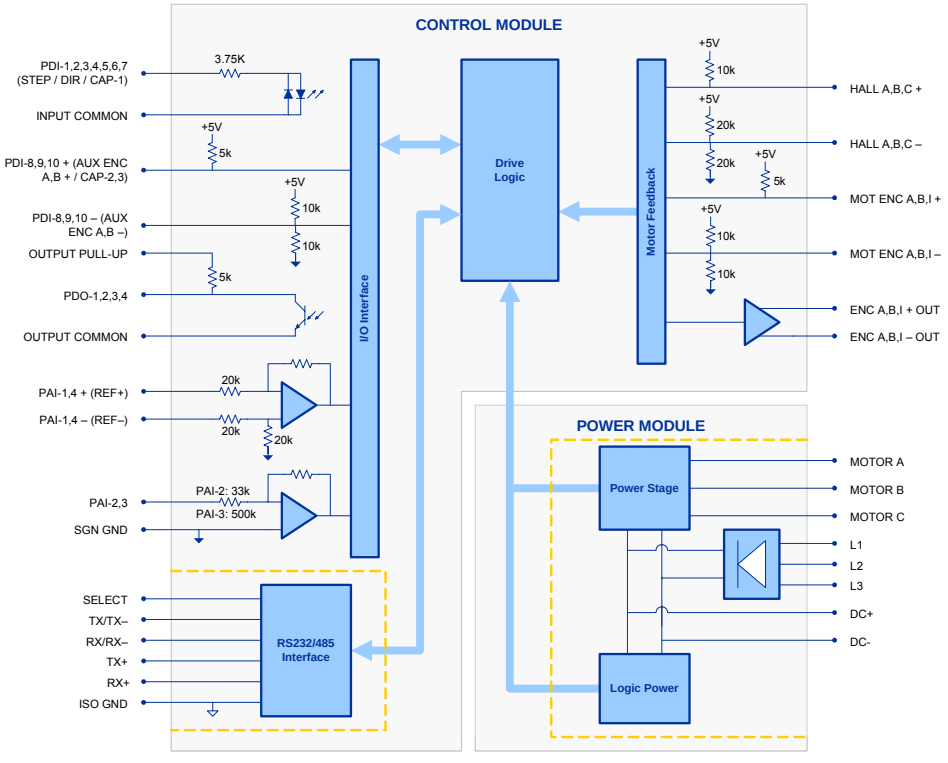
BLOCK DIAGRAM



Approvals and Compliances	
c UL us	US and Canadian safety compliance with UL 508c, the industrial standard for power conversion electronics. UL registered under file number E140173. Note that machine components compliant with UL are considered UL registered as opposed to UL listed as would be the case for commercial products.
CE	Compliant with European CE for both the Class A EMC Directive 89/336/EEC on Electromagnetic Compatibility (specifically EN 61000-6-4:2001, EN 61000-6-2:2001, EN 61000-3-2:2000, and EN 61000-3-3:1995/A1:2001) and LVD requirements of directive 73/23/EEC (specifically EN 60204-1), a low voltage directive to protect users from electrical shock.
RoHS COMPLIANCE	RoHS (Reduction of Hazardous Substances) is intended to prevent hazardous substances such as lead from being manufactured in electrical and electronic equipment.

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SPECIFICATIONS

Power Specifications		
Description	Units	Value
AC Supply Voltage Range	VAC	90 - 264
Nominal AC Supply Voltage	VAC	120 - 240
Rated Supply Voltage	VAC	240
AC Input Phases[1]	-	3
AC Supply Frequency	Hz	50 - 60
DC Supply Voltage Range	VDC	127 - 373
DC Bus Over Voltage Limit	VDC	393.8
DC Bus Under Voltage Limit	VDC	55
Maximum Peak Output Current	A (Arms)	15 (10.6)
Maximum Continuous Output Current	A (Arms)	7.5 (5.3)
Max. Continuous AC Current Draw @ Rated Voltage	A	4.3
Max. Continuous Output Power @ Rated Voltage	W	1710
Max. Continuous Power Dissipation @ Rated Voltage	W	90
Internal Bus Capacitance	µF	660
Minimum Load Inductance (Line-To-Line)[2]	µH	600
Switching Frequency	kHz	20
Low Voltage Supply Outputs	-	+5 VDC (250 mA)

Control Specifications		
Description	Units	Value
Communication Interfaces	-	RS-232, RS-485
Command Sources	-	24 V Step & Direction, ±10 V Analog, Encoder Following
Feedback Supported	-	±10 V Analog, Auxiliary Incremental Encoder, Halls, Incremental Encoder
Commutation Methods	-	Sinusoidal, Trapezoidal
Modes of Operation	-	Current, Position, Velocity
Motors Supported	-	Brushed, Brushless, Induction, Voice Coil
Hardware Protection	-	40+ Configurable Functions, Over Current, Over Temperature (Drive & Motor), Over Voltage, Short Circuit (Phase-Phase & Phase-Ground), Under Voltage
Programmable Digital Inputs/Outputs (PDIs/PDOs)	-	10/4
Programmable Analog Inputs/Outputs (PAIs/PAOs)	-	4/0
Current Loop Sample Time	µs	50
Velocity Loop Sample Time	µs	100
Position Loop Sample Time	µs	100
Maximum Encoder Frequency	MHz	20 (5 pre-quadrature)

Mechanical Specifications		
Description	Units	Value
Agency Approvals	-	CE Pending, RoHS, UL/cUL Pending
Size (H x W x L)	mm (in)	177.5 x 139.7 x 55.9 (7 x 5.5 x 2.2)
Weight	g (oz)	1264 (44.6)
Heatsink (Base) Temperature Range[3]	°C (°F)	0 - 65 (32 - 149)
Storage Temperature Range	°C (°F)	-40 - 85 (-40 - 185)
Cooling System	-	Natural Convection
Form Factor	-	Stand Alone
IP Rating	-	IP10
AUX ENCODER Connector	-	15-pin, high-density, male D-sub
COMM Connector	-	9-pin, female D-sub
FEEDBACK Connector	-	15-pin, high-density, female D-sub
I/O Connector	-	26-pin, high-density, female D-sub
P1 Connector	-	8-port, 7.62 mm spaced, enclosed, friction lock header

Notes

1. Can operate on single-phase 120/240 VAC if peak/cont. current ratings are reduced by at least 30%.
2. Lower inductance is acceptable for bus voltages well below maximum. Use external inductance to meet requirements.
3. Additional cooling and/or heatsink may be required to achieve rated performance.

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PIN FUNCTIONS

AUX ENCODER - Auxiliary Feedback Connector			
Pin	Name	Description / Notes	I/O
1	RESERVED	Reserved	-
2	RESERVED	Reserved	-
3	RESERVED	Reserved	-
4	PDI-8 + (AUX ENC A+ / CAP-2)	Programmable Digital Input or Auxiliary Encoder or High Speed Capture	I
5	PDI-8 - (AUX ENC A-)	Programmable Digital Input or Auxiliary Encoder (For Differential Signals Only)	I
6	PDI-9 + (AUX ENC B+ / CAP-3)	Programmable Digital Input or Auxiliary Encoder or High Speed Capture	I
7	PDI-9 - (AUX ENC B-)	Programmable Digital Input or Auxiliary Encoder (For Differential Signals Only)	I
8	PDI-10 +	Programmable Digital Input	I
9	PDI-10 -	Programmable Digital Input (For Differential Signals Only)	I
10	SGN GND	Signal Ground	SGND
11	SGN GND	Signal Ground	SGND
12	SGN GND	Signal Ground	SGND
13	+5V OUT	+5V Encoder Supply Output (Short Circuit Protected)	O
14	PAI-4 +	Differential Programmable Analog Input (12-bit Resolution)	I
15	PAI-4 -		I

COMM - RS232/RS485 Communication Connector			
Pin	Name	Description / Notes	I/O
1	SELECT	RS232/485 selection. Pull to ground (CN1-5) for RS485.	I
2	RS232 TX / RS485 TX-	Transmit Line (RS-232 or RS-485)	O
3	RS232 RX / RS485 RX-	Receive Line (RS-232 or RS-485)	I
4	RESERVED	Reserved	-
5	ISO GND	Isolated Signal Ground	IGND
6	RS485 TX+	Transmit Line (RS-485)	O
7	RESERVED	Reserved	-
8	RS485 RX+	Receive Line (RS-485)	I
9	RESERVED	Reserved	-

FEEDBACK - Feedback Connector			
Pin	Name	Description / Notes	I/O
1	HALL A+	Commutation Sensor Inputs	I
2	HALL B+		I
3	HALL C+		I
4	MOT ENC A+	Differential Encoder A Channel Input (For Single Ended Signals Use Only The Positive Input)	I
5	MOT ENC A-		I
6	MOT ENC B+	Differential Encoder B Channel Input (For Single Ended Signals Use Only The Positive Input)	I
7	MOT ENC B-		I
8	MOT ENC I+	Differential Encoder Index Input (For Single Ended Signals Use Only The Positive Input)	I
9	MOT ENC I-		I
10	HALL A-	Commutation Sensor Input (For Differential Signals Only)	I
11	HALL B-	Commutation Sensor Input (For Differential Signals Only)	I
12	SGN GND	Signal Ground	SGND
13	+5V OUT	+5V Encoder Supply Output (Short Circuit Protected)	O
14	PAI-3	Programmable Analog Input (12-bit Resolution)	I
15	HALL C-	Commutation Sensor Input (For Differential Signals Only)	I

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I/O - Signal Connector			
Pin	Name	Description / Notes	I/O
1	PDO-1	Isolated Programmable Digital Output	O
2	OUTPUT COMMON	Digital Output Common	OGND
3	PDO-2	Isolated Programmable Digital Output	O
4	PAI-1 + (REF+)	Differential Programmable Analog Input or Reference Signal Input (16-bit Resolution)	I
5	PAI-1 - (REF-)		I
6	PAI-2	Programmable Analog Input (12-bit Resolution)	I
7	SGN GND	Signal Ground	SGND
8	OUTPUT PULL-UP	Digital Output Pull-Up For User Outputs	I
9	PDI-5	Isolated Programmable Digital Input	I
10	PDO-3	Isolated Programmable Digital Output	O
11	PDI-1	Isolated Programmable Digital Input	I
12	PDI-2	Isolated Programmable Digital Input	I
13	PDI-3	Isolated Programmable Digital Input	I
14	PDO-4	Isolated Programmable Digital Output	O
15	INPUT COMMON	Digital Input Common (Can Be Used To Pull-Up Digital Inputs)	IGND
16	SGN GND	Signal Ground	SGND
17	PDI-4 (STEP)	Isolated Programmable Digital Input or Step	I
18	PDI-6 (DIR)	Isolated Programmable Digital Input or Direction	I
19	PDI-7 (CAP-1)	Isolated Programmable Digital Input or High Speed Capture	I
20	ENC A+ OUT	Buffered Encoder Channel A Output	O
21	ENC A- OUT		O
22	ENC B+ OUT	Buffered Encoder Channel B Output	O
23	ENC B- OUT		O
24	ENC I+ OUT	Buffered Encoder Index Output	O
25	ENC I- OUT		O
26	SGN GND	Signal Ground	SGND

P1 - Power Connector			
Pin	Name	Description / Notes	I/O
1	MOTOR A	Motor Phase A	O
2	MOTOR B	Motor Phase B	O
3	MOTOR C	Motor Phase C	O
4	DC+	Internal DC Bus Voltage (Can Be Used To Connect External Shunt Regulator)	O
5	DC-		O
6	L1	AC Supply Input (Single or Three Phase)	I
7	L2		I
8	L3		I

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HARDWARE SETTINGS

Switch Functions

Switch	Description	Setting	
		On	Off
1	Bit 0 of binary RS-485 drive address. Does not affect RS-232 settings.	1	0
2	Bit 1 of binary RS-485 drive address. Does not affect RS-232 settings.	1	0
3	Bit 2 of binary RS-485 drive address. Does not affect RS-232 settings.	1	0
4	Bit 3 of binary RS-485 drive address. Does not affect RS-232 settings.	1	0
5	Bit 4 of binary RS-485 drive address. Does not affect RS-232 settings.	1	0
6	Bit 5 of binary RS-485 drive address. Does not affect RS-232 settings.	1	0
7	Bit 0 of drive RS-485 baud rate setting. Does not affect RS-232 settings.	1	0
8	Bit 1 of drive RS-485 baud rate setting. Does not affect RS-232 settings.	1	0

Additional Details

The drive can be configured to use the address and/or bit rate stored in non-volatile memory by setting the address and/or bit rate value to 0. Use the table below to map actual bit rates to a bit rate setting.

Baud Rate (kbps)	Value For Bit Rate Setting
Load from non-volatile memory	0
9.6	1
38.4	2
115.2	3

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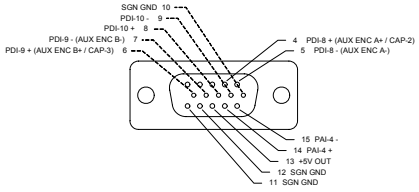
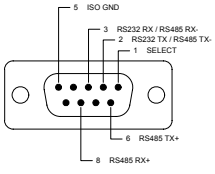
MECHANICAL INFORMATION

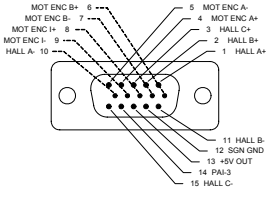
AUX ENCODER - Auxiliary Feedback Connector		
Connector Information		15-pin, high-density, male D-sub
Mating Connector	Details	AMP: Plug P/N 748364-1; Housing P/N 748677-1; Terminals P/N 748610-4 (loose) or 748610-2 (strip)
	Included with Drive	No


SGN GND 10
PDI-10 - 9
PDI-10 + 8
PDI-9 - (AUX ENC B-) 7
PDI-9 + (AUX ENC B+ / CAP-3) 6
4 PDI-8 + (AUX ENC A+ / CAP-2)
5 PDI-8 - (AUX ENC A-)
15 PAI-4 -
14 PAI-4 +
13 +5V OUT
12 SGN GND
11 SGN GND

COMM - RS232/RS485 Communication Connector		
Connector Information		9-pin, female D-sub
Mating Connector	Details	AMP: Plug P/N 205204-4; Housing P/N 748677-1; Terminals P/N 5-66507-7 (loose) or 3-66507-0 (strip)
	Included with Drive	No



FEEDBACK - Feedback Connector		
Connector Information		15-pin, high-density, female D-sub
Mating Connector	Details	AMP: Plug P/N 748364-1; Housing P/N 748677-1; Terminals P/N 748333-4 (loose) or 748333-2 (strip)
	Included with Drive	No



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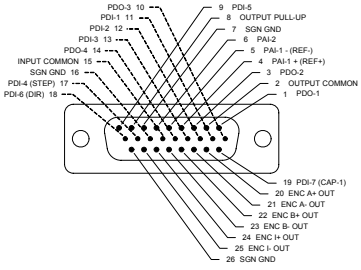
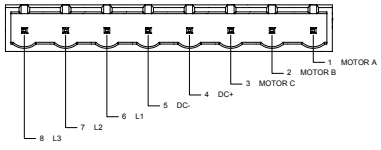
I/O - Signal Connector		
Connector Information		26-pin, high-density, female D-sub
Mating Connector	Details	AMP: Plug P/N 748365-1; Housing P/N 748677-2; Terminals P/N 748333-4 (loose) or 748333-2 (strip)
	Included with Drive	No



P1 - Power Connector		
Connector Information		8-port, 7.62 mm spaced, enclosed, friction lock header
Mating Connector	Details	Phoenix Contact: P/N 1767067
	Included with Drive	Yes



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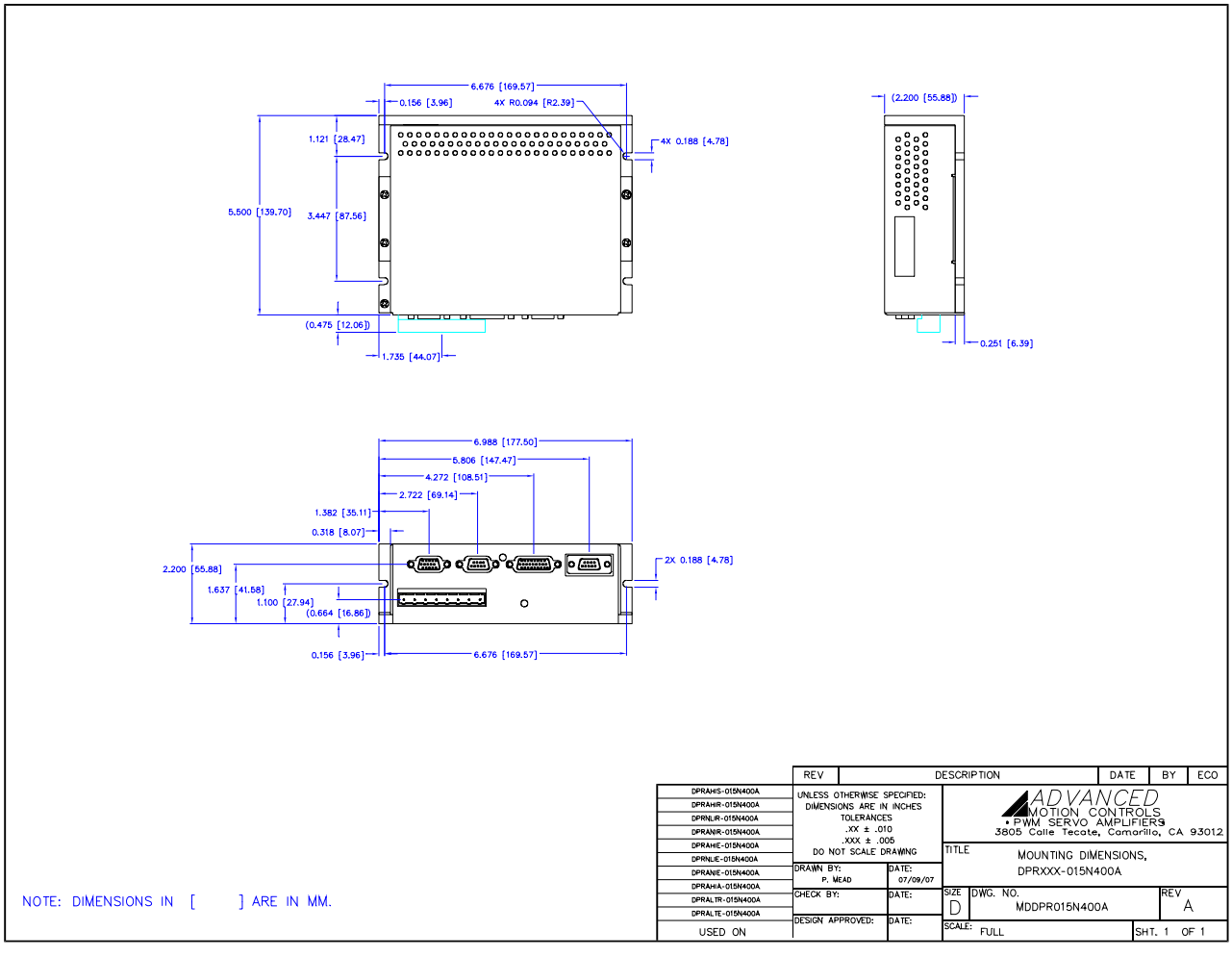
MOUNTING DIMENSIONS



NOTE: DIMENSIONS IN [ ] ARE IN MM.

REV	DESCRIPTION	DATE	BY	ECO

DPRAHIS-015N400A
DPRAHIR-015N400A
DPRNLR-015N400A
DPRANR-015N400A
DPRAHIE-015N400A
DPRNLE-015N400A
DPRANE-015N400A
DPRAHIA-015N400A
DPRALTR-015N400A
DPRALTE-015N400A
USED ON

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES
TOLERANCES
.XX ± .010
.XXX ± .005
DO NOT SCALE DRAWING

DRAWN BY: P. MEAD — DATE: 07/09/07
CHECK BY: — DATE:
DESIGN APPROVED: — DATE:

ADVANCED MOTION CONTROLS
• PWM SERVO AMPLIFIERS
3805 Calle Tecate, Camarillo, CA 93012

TITLE: MOUNTING DIMENSIONS, DPRXXX-015N400A

SIZE: D | DWG. NO.: MDDPR015N400A | REV: A

SCALE: FULL | SHT. 1 OF 1

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PART NUMBERING INFORMATION

Example: D P R A N I E - 0 1 5 A 4 0 0 -

Drive Series

DP	DigiFlex Performance

Communication

R	RS232/RS485
C	CANopen or RS232
Q	SynqNet

Command Inputs

AN	Analog (±10V) No Step & Direction
AL	Analog (±10V) Low Voltage Step & Direction (5V)
AH	Analog (±10V) High Voltage Step & Direction (24V)
NL	No Analog Low Voltage Step & Direction (5V)
NN	No Analog, No Step & Direction (Communication Interface Only)

Digital I/O

I	Isolated (24V)
T	TTL (5V) Non-Isolated

Motor Feedback

E	Incremental Encoder and/or Halls
R	Resolver
A	Absolute Sin/Cos (Hiperface & Endat)
S	Sin/Cos with Halls

Customer Special

Code used to identify customer specials

Revision

A through Z (letters may be skipped)

Max DC Bus Voltage (V_{DC})

080	80
200	200
400	400
800	800

Power and Logic Supply

A	AC Input +24V_{DC} User Logic Supply Required
N	AC Input Only No Logic Supply Required (Internal Supply)
B	DC Input Both Logic Supply Options (Internal or User)
L	DC Input Logic Supply Required
D	DC Input Only Internal Logic Supply

Peak Current ($A_{0\ to\ Peak}$)

015	15
016	16
020	20
025	25
030	30
040	40
060	60
100	100

DigiFlex®Performance™ series of products are available in many configurations. All models listed in the selection tables of the website are readily available, standard product offerings. Other combinations or possibilities can be made available for OEMs with sufficient volume requests. Feel free to contact Applications Engineering for further information and details.

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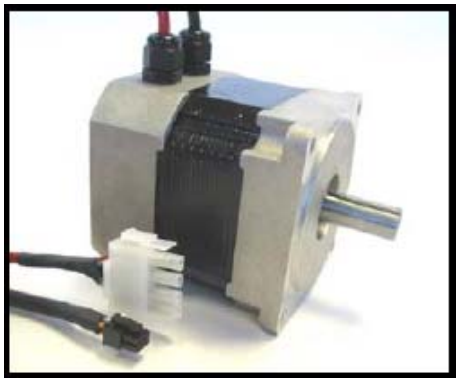
MBL3410E2 BRUSHLESS SERVO MOTOR

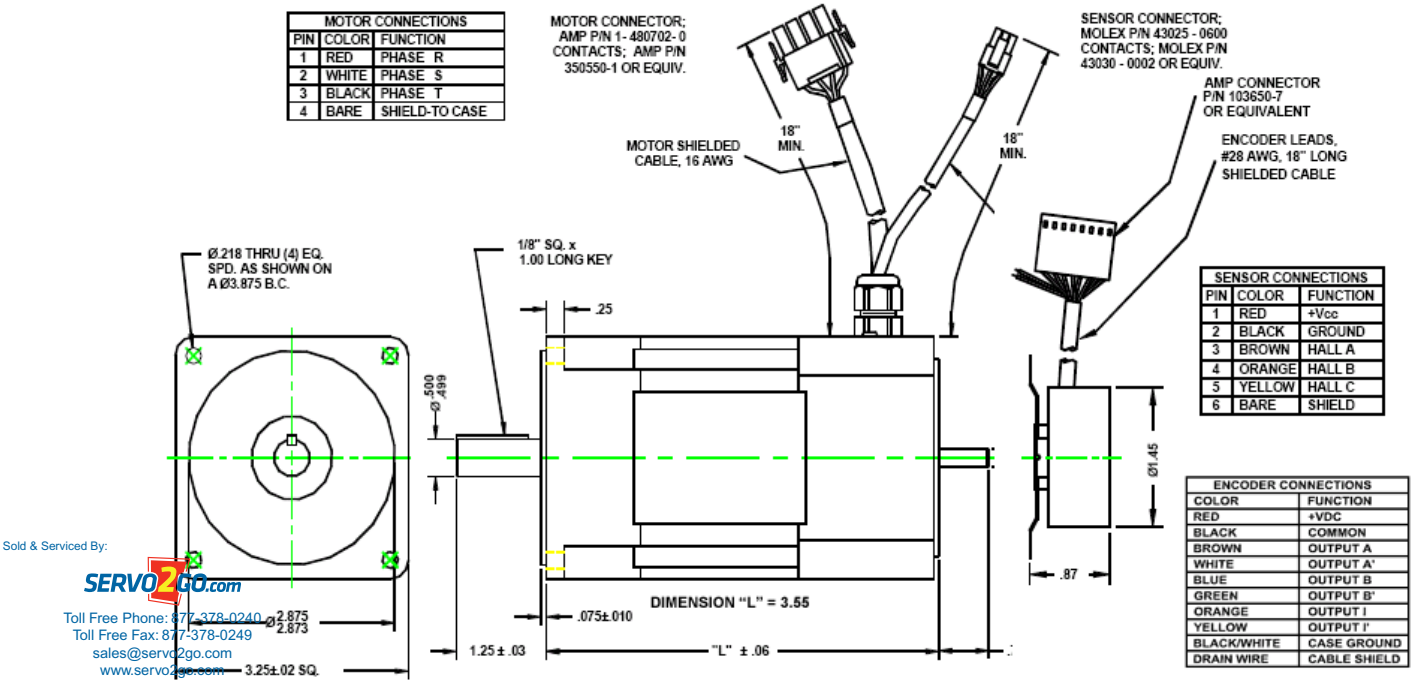
FEATURES:

- 3.25 Inch NEMA 34 w/ Heavy Duty Shaft
- Continuous Torques up to 11.56 lb-in
- Speeds up to 6000 rpm
- Voltage Rating up to 170 Vdc
- Integrated Hall Effect Commutation
- 30 Lb Radial Load Capacity, 1/2" from Front Face
- High Precision Optical Encoders – 10000 count



SPECIFICATIONS:

SPECIFICATIONS	UNITS	VALUE
CONTINUOUS TORQUE	Nm (lb-in)	1.31 (11.56)
PEAK TORQUE	Nm (lb-in)	3.89 (34.4)
SPEED @ RATED VOLTAGE	RPM	6000
RATED VOLTAGE	V dc	170
CONTINUOUS CURRENT	A	8.9
PEAK CURRENT	A	26.5
TORQUE CONSTANT	Nm / A (lb-in / A)	0.159 (1.41)
VOLTAGE CONSTANT	V / KRPM	16.7
RESISTANCE	ohms	0.405
INDUCTNACE	mH	1.69
INERTIA	kg-cm² (lb-in-s²)	1.243 (0.0011)
WEIGHT	Kg (lb)	2.49 (5.5)



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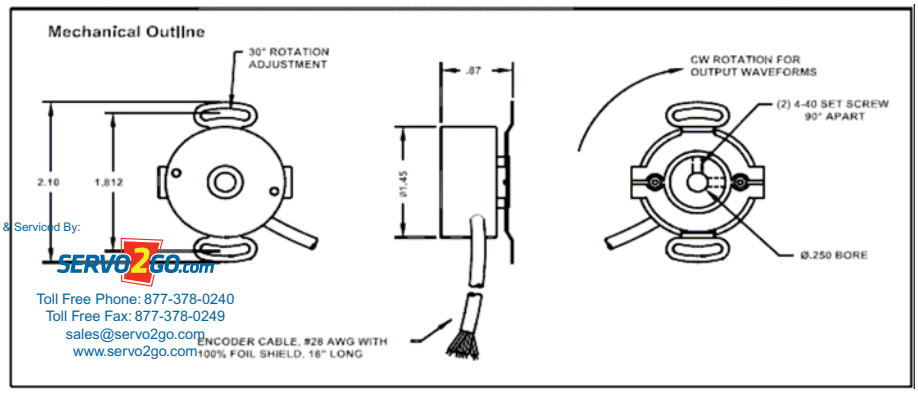
ENCODER:

ELECTRICAL SPECIFICATIONS	VALUE
INPUT VOLTAGE	5 VDC +/- 5%
INPUT CURRENT REQUIREMENTS	125 mA Typical @ 5 VDC Plus Interface Loads
INPUT RIPPLE	2% Peak to Peak @ 5 VDC
OUTPUT CIRCUITS	AM26LS31 RS 422A Line Driver
FREQUENCY RESPONSE	500 kHz
INCREMENTAL OUTPUT FORMAT	Quadrature with A leading B for CW rotation. Index Pulse centered over A.
SYMMETRY	180 Degrees +/- 10% Typical
MINIMUM EDGE SEPARATION	54 electrical degrees
COMMUTATION FORMAT	N/A
COMMUTATION ACCURACY	N/A

ENVIRONMENTAL SPECIFICATIONS	VALUE
STORAGE TEMPERATURE	-40 to 125° C
OPERATING TEMPERATURE	-20 to 100° C Typical
HUMIDITY	98% Non-Condensing
VIBRATION	20 G's @ 50 to 500 CPS
SHOCK	50 G's @ 11 ms duration

MECHANICAL SPECIFICATIONS	VALUE
LINE COUNT	2500 lines/revolution
MAXIMUM SHAFT SPEED	8000 RPM
THROUGH SHAFT DIAMETER	0.250" (-0.0000", +0.0005")
RADIAL SHAFT MOVEMENT	0.007" TIR
AXIAL SHAFT MOVEMENT	+/- 0.030" MAX
HOUSING	Carbon Fiber Composite (case ground via cable)
TERMINATION	15 conductor cable, 28 AWG, 18" long
MOUNTING	1.812" Bolt Circle
MOMENT OF INERTIAL	1.5×10^{-4} oz-in-s^2
ACCELERATION	1×10^5 Radians/s^2
ACCURACY	+/- 1.0 Arc Minutes



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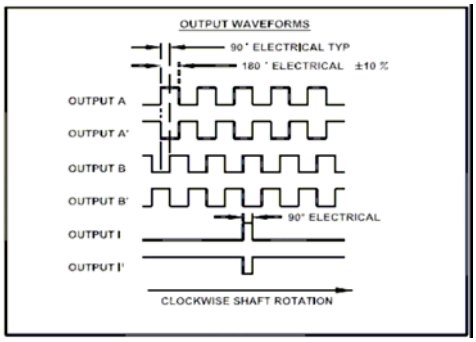


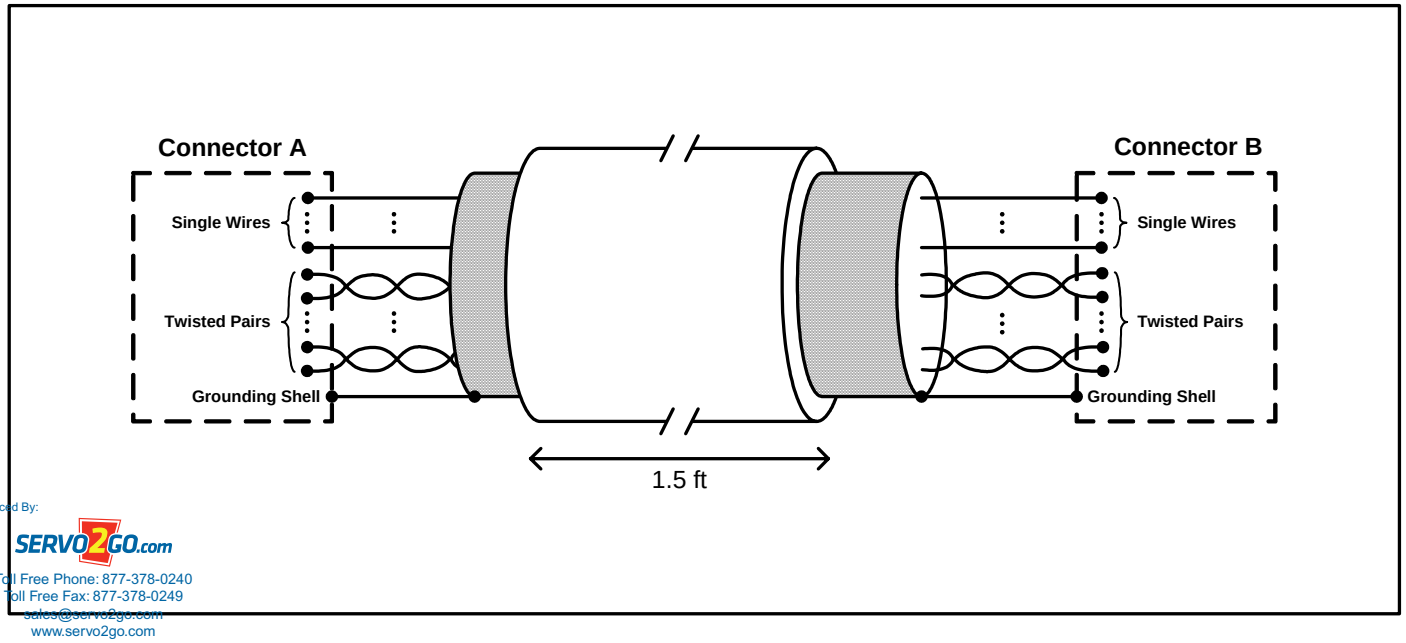
CBL-D03 DRIVE CABLE

WIRING SPECIFICATIONS:

CABLE: CBL-D03						
Side 1 (Drive)		**Common**			**Side 2 (SIB)**	
Connector	**Contact**	**Wiring Scheme**	**Function**	**Wire Color**	**Contact**	**Connector**
A **26-Pin AMP (D-SUB)** Plug: P/N 748365-1 Housing: P/N 748677-2 Terminals: P/N 748333-4	1	Single Wire	PDO1	red/black	1	**B** **26-Pin AMP (D-SUB)** Plug: P/N 748365-1 Housing: P/N 748677-2 Terminals: P/N 748333-4
	2	Single Wire	SGND	pink	2	
	3	Single Wire	PDO2	blue	3	
	6	Single Wire	PAI2	blue/white	6	
	7	Single Wire	PAO1	black	7	
	8	Single Wire	PAO2	black/white	8	
	10	Single Wire	PDO3	orange	10	
	11	Single Wire	PDI1	orange/white	11	
	12	Single Wire	PDI2	orange/black	12	
	13	Single Wire	PDI3	white	13	
	14	Single Wire	PDO4	yellow	14	
	19	Single Wire	PDI4	yellow/black	19	
	4	Twisted Pair	+REF	green	4	
	5		-REF	green/white	5	
	9	Twisted Pair	-PDI6	purple	9	
	18		+PDI6	purple/white	18	
	15	Twisted Pair	5V	red	15	
	16		SGND	red/white	16	
	17	Twisted Pair	+PDI5	gray	17	
	26		-PDI5	gray/black	26	
	20	Twisted Pair	Encoder A+	brown	20	
	21		Encoder A-	brown/white	21	
	22	Twisted Pair	Encoder B+	pink/red	22	
	23		Encoder B-	pink/black	23	
	24	Twisted Pair	Encoder I+	green/black	24	
	25		Encoder I-	light green	25	
	Shell	Shield	Shield	-	Shell	

NOTE: For cables with only twisted pairs, single wires can be paired with other single or unused wires.

DIAGRAM:



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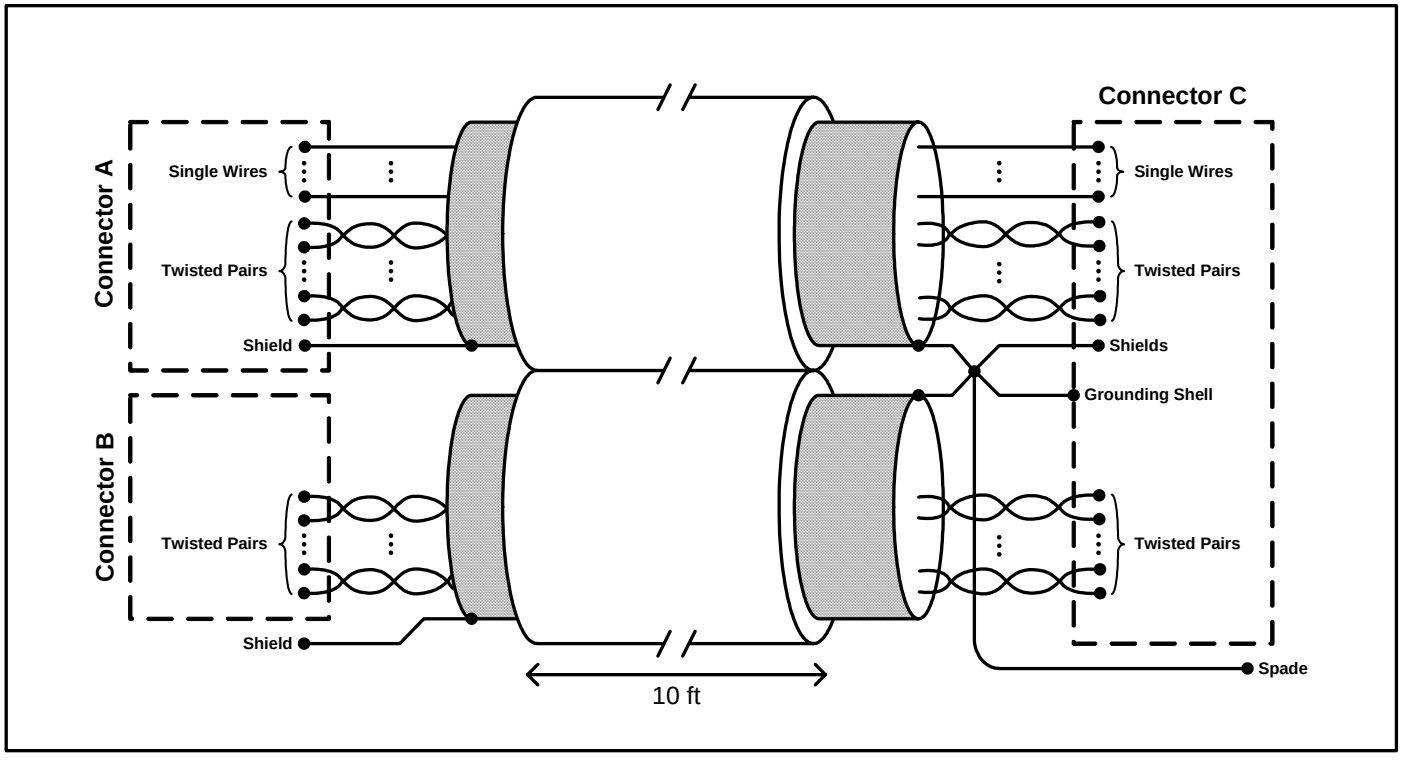
CBL-F02-10 FEEDBACK CABLE

WIRING SPECIFICATIONS:

CABLE: CBL-F02-10						
Side 1		**Common**			**Side 2**	
Connector	**Contact**	**Wiring Scheme**	**Function**	**Wire Color**	**Contact**	**Connector**
A **6-Pin Molex** Connector: P/N 43020-0601 Terminals: P/N 43031-0002	3	Single Wire	Hall A	Brown	1	**C** **15-Pin AMP (D-SUB)** Plug: P/N 748364-1 Housing: P/N 748677-1 Terminals: P/N 748333-4
	4	Single Wire	Hall B	Orange	2	
	5	Single Wire	Hall C	Yellow	3	
	1	Twisted Pair	5V	Red	13	
	2		SGND	Black	12*	
	6	Shield	Shield	White/Black	Shell*	
B **8-Pin Molex** Connector: P/N 70107-0007 Terminals: P/N 16-02-0077	3	Twisted Pair	A+	Brown	4	
	4		A-	White	5	
	5	Twisted Pair	B+	Blue	6	
	6		B-	Green	7	
	7	Twisted Pair	I+	Orange	8	
	8		I-	Yellow	9	
	1	Twisted Pair	5V	Red	13	
	2		SGND	Black	12*	
	Flying Lead	Shield	Shield	-	Shell*	
	-	-	-	-	Shell*	Spade

* Indicates contacts that share continuity with the connector shell (see diagram).

DIAGRAM:



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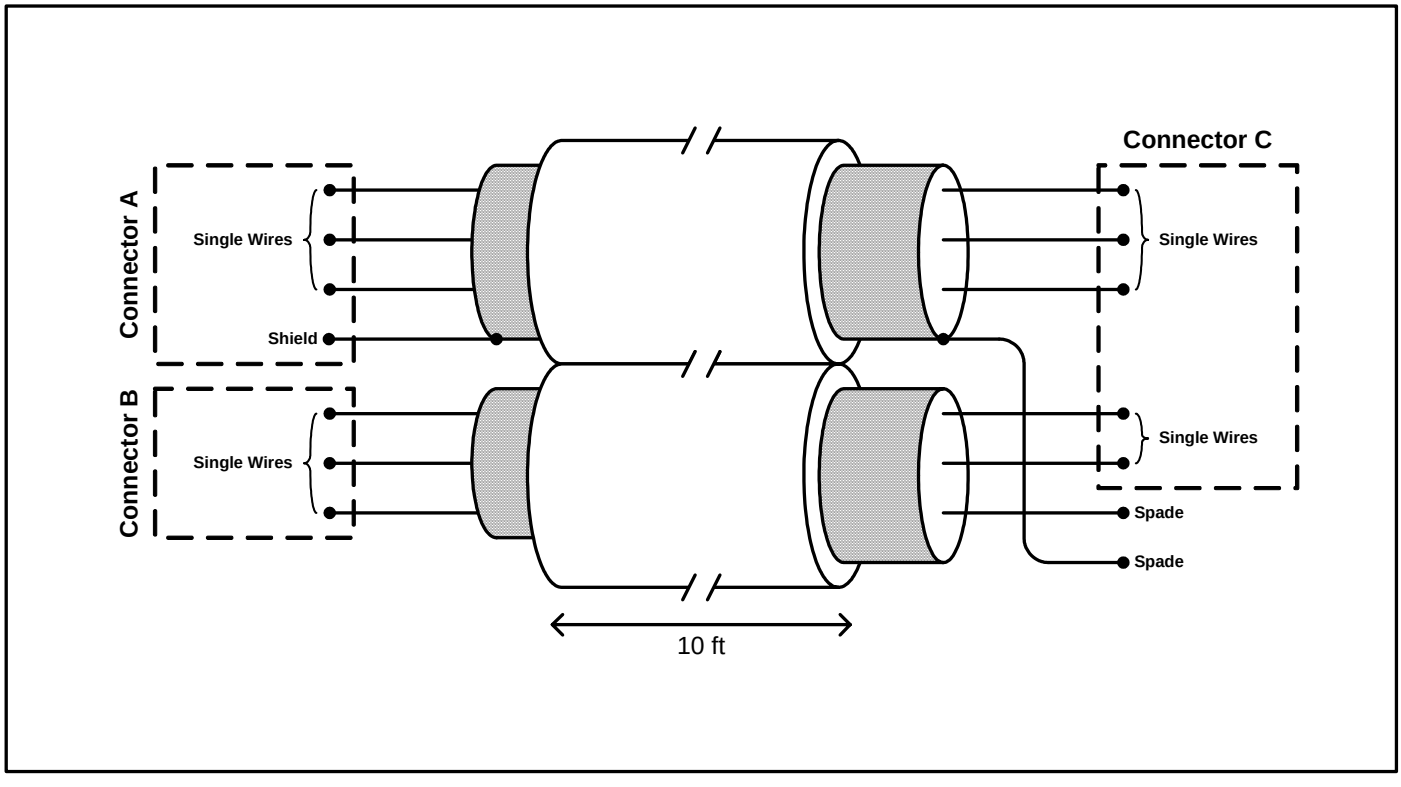
CBL-P05-10 POWER CABLE

WIRING SPECIFICATIONS:

CABLE: CBL-P05-10						
Side 1		Common			Side 2	
Connector	Contact	Wiring Scheme	Function	Wire Color	Contact	Connector
A (4-Pin AMP) Connector, Terminals: P/N 1-480703-0, P/N 350873-1	1	Single Wire	Motor A	red	1	**B (8-Port Phoenix)** Connector: P/N 1767067
	2	Single Wire	Motor B	white	2	
	3	Single Wire	Motor C	black	3	
	4	Shield	Shield	grey	Spade	
B (AC Cable)	1	Single Wire	AC Neutral	white	6	
	2	Single Wire	AC Hot	black	7	
	3	Single Wire	Earth Ground	green	Spade	

DIAGRAM:



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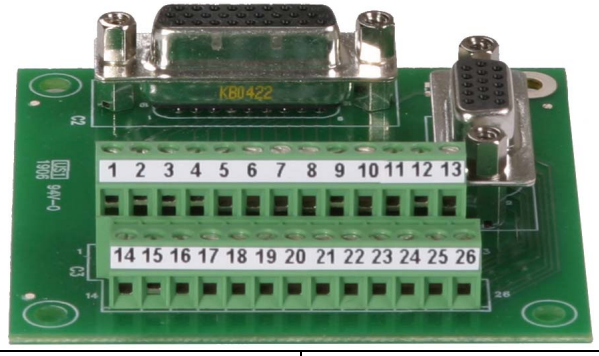
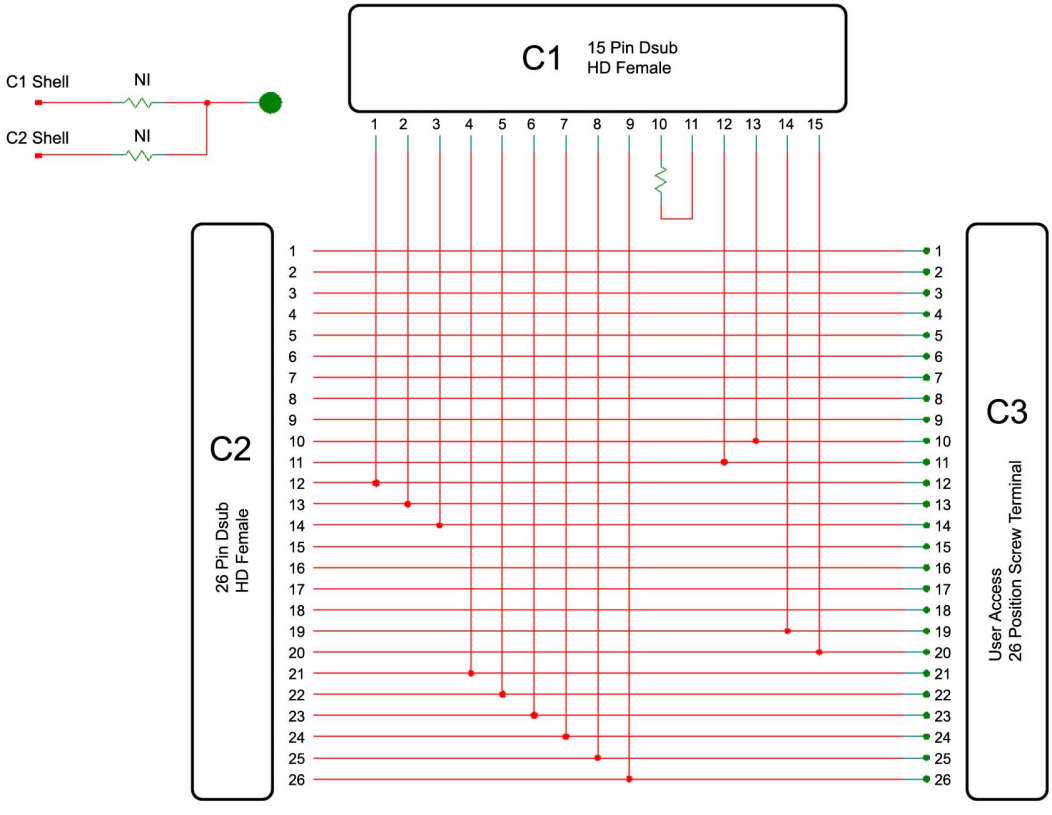
System Interface Board (SIB)



Dimensions	72mm x 72mm
C1 Connector	15 pin to motor
C2 Connector	26 pin to drive
C3 Connector	26 pin user interface.

C3 Pin Functions

Pin	Function
1	PDO-1
2	OUTPUT COMMON
3	PDO-2
4	PAI-1 +
5	PAI-1 -
6	PAI-2
7	SGN GND
8	OUTPUT PULL-UP
9	PDI-5
10	PDO-3
11	PDI-1
12	PDI-2
13	PDI-3
14	PDO-4
15	INPUT COMMON
16	SGN GND
17	PDI-4
18	PDI-6
19	PDI-7
20	ENCODER A+
21	ENCODER A-
22	ENCODER B+
23	ENCODER B-
24	ENCODER I+
25	ENCODER I-
26	SGN GND


C1 Shell
NI
C2 Shell
NI
C1
15 Pin Dsub
HD Female
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
C2
26 Pin Dsub
HD Female
C3
User Access
26 Position Screw Terminal
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26

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